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THE ARCHITECTURE OF BIJAPUR & Gal Gumbaz.

By S. S. REUBEN, F.R.I.B.A., F.I.I.A.,

Assistant Professor of Architecture, Sir J. J. School of Art, Bombay.

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THE ARCHITECTURE OF BIJAPUR

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Illustration No. 1

LAYOUT

BIJAPUR, once the capital of the Deccan, is situated about 350 miles to the south-east of Bombay. A tourist from Bombay travels on the G.I.P. Railway main line from Bombay to Madras and gets down at Hotgi Junction, which is on the 292nd mile stone. From here the metre-gauge line of the Southern Mahratta Railway brings him, after a short distance of 58 miles, to the City of Bijapur.

The town is situated in north latitude $16^{\circ}50'$ and east longitude $75^{\circ}52'$, at an elevation of 2,000 feet above sea-level. It is surrounded, for the most part, by long stretches of dry, barren, stony soil, treeless plains, with little vegetation and due to the geological condition of the soil, the town has no "landscape setting" from the point of view of landscape architecture.

● HISTORICAL OUTLINE :

The Adil Shahi dynasty was established in the year 1489, by Yusuf Adil Shah, and made Bijapur their capital where they ruled from 1489 to 1686.

A chronological table of the Adil Shahi dynasty of Bijapur is given below :—

Yusuf Adil Shah	(1489-1510)
Ismail Adil Shah	(1510-1534)
Ibrahim I Adil Shah	(1534-1557)
Ali I Adil Shah	(1557-1580)
Ibrahim II Adil Shah	(1580-1626)
Muhammad Adil Shah	(1626-1656)
Ali II Adil Shah	(1656-1672)
Shikandar Adil Shah	(1672-1686)

The above reigns of the kings of Bijapur correspond very nearly with the reigns of the kings of England, on the British throne, that is from Richard III (1483) to James II (1685).

The Adil Shahis were at constant wars with the Hindu kingdom of Vijayanagar for supremacy. For nearly half a century they had to fight with Vijayanagar till it was overthrown at the battle of Talikota in 1565.

The early kings of the Adil Shahi dynasty were too much occupied by wars and the struggle for existence was too severe to admit of much leisure for indulgence in the luxury of art. Yusuf Adil Shah and his two successors followed the usual practice in India in using Hindu craftsmen and building mosques and tombs with the materials of the Hindu temples they destroyed. It was not until the time of Ali Adil Shah I that Bijapur developed a characteristic building tradition of its own, which was grafted upon the older Hindu traditions but adapted to Mahomedan ritual. It is in this period that we really enter on the great building epoch of the city; all the great monuments being crowded into the 100 years that remained before the wars of Aurangzeb put an end to the glory of Bijapur, in the middle of the seventeenth century. In a political sense, Bijapur ceased to exist after its capture by the Emperor Aurangzeb.

It was the ruling passion of the Mahomedan kings, to build a monument or a memorial for their remains after death, which has been the main cause of these exquisite and grand works of art. It is therefore necessary that we should know the history of the dynasty whose love of architecture manifests itself in every building of Bijapur.

Every king built a tomb for himself during his life time and if he died prematurely his tomb was left unfinished because his successor was too busy erecting his own tomb, and each succeeding king tried to make his tomb more monumental than that of his predecessor.

Since the fall of the Adil Shahis, Bijapur passed from hand to hand, from Peshwas to the king of Satara, till finally with the end of Satara, it reverted to the British. On 17th May, 1818, Bijapur became the possession of the British.

The historic monuments have now come under the care of the Department of Archaeology and to-day the chief monuments of the city present a neat and well protected appearance.

● OLD BIJAPUR CITY :

Building operations on this site (see layout in illustration No. 1) began during the latter half of the 15th century. The construction of the walls of the citadel, a fortress irregularly circular in plan and containing a palace and imperial buildings, was begun by Yusuf Adil Shah in 1489 and were continued by his successors upto the reign of Ali Adil Shah I who died in 1579. As the power of the Adil Shahis increased, around the citadel a city was gradually formed, and in the course of time was enclosed within strongly fortified walls. The trace of these city walls is also an irregular circle and from the citadel in the centre roads radiate to the five principal gates.

The area of the whole city covers about $2\frac{1}{2}$ square miles and the walls and the fortifications that surrounded the city had a circuit of about $6\frac{1}{2}$ miles. The city walls have five principal gates.

- (1) The Mekka Gate on the West.
- (2) The Shahapur Gate at the North-West corner.
- (3) The Behamani Gate on the North.
- (4) The Allapur Gate on the east.
- (5) The Fateh Gate on the south-east.

Besides these, there are smaller ones also. The walls have been built of stone and mortar and the space between the outer and the inner wall being well rammed up with earth. Outside the walls and running nearly the whole length is a deep broad moat.

No Mahomedan city could be without an abundance of gardens. An ample and regular water supply was hence the prime necessity. The Bijapur kings were lovers of gardens and they have constructed water-works which were perfect in their time.

Abundant and wholesome water was supplied to the entire city and its innumerable gardens from the two principal sources, one from Torwee, four miles to the west and the other from Begum Talao to the south. From Torwee a great underground tunnel carried the water to the city. The direction of this underground tunnel can be easily traced by the stone air shafts built at regular intervals along the route. The water from Begum Talao was brought in earthenware pipes, specimens of which could be seen by the visitor in the Archaeological Museum attached to the Gol Gumbaz.

Besides these outside sources, the city had innumerable wells and tanks. The most important of these being Taj Bauri and the Chand Bauri. The Mahals of Adil Shahs and those of the chief noblemen had innumerable fountains, running water, spouts, and clever devices to carry water on every floor and thus produce a cooling effect in the hot days of scorching and dry summer.

● TOWN PLANNING :

The characteristic features which distinguish the towns of ancient India from the present day cities are their strong fortifications. Exactly in a similar way were the ancient Greek and Roman towns fortified by walls.

The layout of Bijapur (shown in illustration No. 1) shows that the principles of town-planning were observed by the town-planners even in those olden times in view of the fact that the citadel, containing the palaces and imperial buildings, was well anchored as a dominant feature of the layout with a ring road around it and roads radiating from this central place, terminating at the city gates. The latent defect in the layout of this historic town is, that the historic monuments are scattered all over regardless of the positions of the roads,

and that there is no proper vista leading to a focal point, such as a historic monument. Further, the roads leading to the city gates follow no direct alignment, nor does there seem to have been any serious attempt at systematic town-planning.

The location of the old water-works and reservoir influenced the siting of this city and led to its development and the city even to-day is inhabited owing to the geographical inertia of the population.

The civic centre was well co-ordinated in relation to the other part of the city and was a good example of "neighbourhood planning" but this layout would not suit the modern needs of to-day.

The ancient town-planning indicated the "diagnostic approach" to the problem and not the "cosmetic approach".

As a preliminary to the planning of a town, the town-planner must take a historical and sociological survey of the site. It would be a sheer disregard if he did not respect the ancient historical relics of the place, if he pulled down and demolished everything that stood in the way of successful execution of his fanciful scheme and left no trace of the past.

The town-planners will certainly fail in their duty if they narrow down their attention only to the construction of the city without any regard for the best arteries of its communication with the outer world and a good "regional plan" should be envisaged, ultimately developing into a "National plan".

While re-planning this town condition of "blight" should be eliminated and fewer houses to the acre, should be constructed.

To the student of Architecture and Town-Planning there is an ample scope for preparing plans of this historic town and re-creation, based on careful study of the existing remains and of the historical data.

● LOCAL MATERIALS :

The builders at Bijapur were greatly handicapped by the limited area from which they were able to draw their material which was necessarily contained within the confines of the state.

Most of the buildings of Bijapur are faced by, and largely constructed, of stone—a local basaltic trap, which underlying the shallow surface soil, was quarried on the spot without difficulty. It is of a very fine grain and remarkably tough consistency, not too hard to work and probably growing harder by exposure. It is of a rich brown or greyish brown colour, takes a high polish and is susceptible of as high and perfect finish as marble. Palaces, tombs, gateways and minarets were all carved from this rich brown basalt of the locality.

The stone used in the facade of the Taj Bauri is of a warm sepia brown, lighter and richer in tone than any other building. It was quarried from the well which is excavated entirely from the basaltic trap.

The stone used in the Mehtar Mahal was not the basaltic trap of the locality. It is the laminar limestone, which is popularly known to geologists under the name of "Kurnool Limestone" found near Talikota, about 30 miles south-east of Bijapur. It begins to appear under the trap and lies between it and the granite. The grain of this stone is very close and fine, the texture hard and tough; its colour, a light yellowish or creamy grey. The transport of the material must have been very laborious and its working far more expensive and tedious than basalt, but no such work could have been executed in basalt and it was only the extreme tenacity of the material which admitted of the intricacy which has been imparted to the perforated brackets and other ornamental features.

The facades of buildings were sometimes finished in stucco-work (fine plaster) covered with gilding and colour. The entrance gateway to the Jami Musjid is richly ornamented with stucco-work in delicate arabesque patterns as also the palaces in the citadel and the floor of the Jami Musjid which was divided into spaces, each sufficient for one person at prayer; they are of white stucco, surrounded by a rim of black.

There are many buildings in which the brickwork is only covered with an exceedingly fine white plaster, the working of which has developed into a fine art in India.

When stone was too expensive an excellent substitute was found in this white plaster. A fine white sand or powdered limestone was used with it; the lime was made in some places from the chips left by the stone cutters, in others from sea-shells. It was so hard and tenacious that it could be used for floors as well as for walls and roofs.

For decorative purposes it could be used as a ground for fresco painting and gilding. For these purposes, it was frequently applied to buildings faced with stone.

This art of fine plaster work is known as "Indian Stucco".

It may be of interest to note that in the Pearl Mosque, it is said that powdered pearls were mixed in the plaster itself.

Most of the damage that has overtaken the monuments has been caused by the cracking and snapping of brackets, tie beams and cornice slabs.

● THE SECRET OF CONSTRUCTION :

The most daring piece of work carried out by the Bijapur builders, in defiance of the ordinary rules and regulations for the construction of buildings was a "hanging ceiling". This mode of ceiling has baffled many modern architects. Upon close examination it is found to be composed of slabs of stone, set edge to edge, with no apparent support. But the architect not only foresaw exactly what he wanted and how to accomplish it, but he had that thorough confidence in his materials, without which no builder ever yet produced anything that was lasting. These old Bijapur buildings have stood the best test any could stand, that of time, and the result proves amply that their builders knew what they were about. The whole secret of this amazing feat, is the great strength and tenacity of the mortar used.

The ceiling of the principal apartment of the tomb of Ibrahim Rouza is one of the most curious and interesting specimens of architectural skill at Bijapur, for it is flat and constructed with stone ribs and slabs set edge to edge, only supported by iron clamping and the strength of the excellent Indian Mortar, without any appearance of arch construction about them.

The ceiling of the entrance hall of the Mehtar Mahal, as well as the ceiling of the upper floor, is constructed in the same manner as that at the Ibrahim Rouza. This is the secret, too, of this flat ceiling.

At the north-east corner of the Taj Bauri is a partly destroyed dome. It is rather flat and is constructed in the same way as this ceiling, with a lining of great flat slabs, which, by themselves could not possibly stand. But they are nothing more than the stone lining of a concrete ceiling, the shear adhesive strength of the mortar keeping them in position. Although the ceiling, as a whole may remain intact yet there is the danger of individual stones dropping out, and this is guarded against by rabbeting the edges and in many cases, fastening adjacent stones with iron clamps.

Such a skilfully built "hanging ceiling" shows that in structural technique the Bijapur masons were masters of their craft.

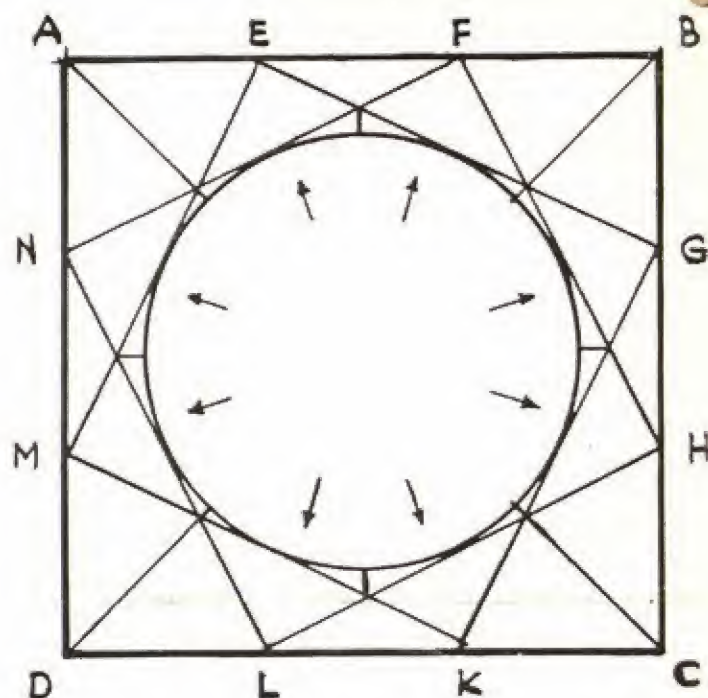


Illustration No. 2

PENDENTIVES

● THE PENDENTIVES :

The famous pendentive system of raising and supporting heavy domical structures was a foreign device introduced in the Deccan from Central Asia *via* Persia during the 14th & 15th centuries. This device, though ever so very artistic and mechanically sound, was not much made use of by the Moghals in their buildings in the North. Even in the Deccan, the device ceased to be widely popular by the end of the 17th century on royal buildings and was hardly adopted to their needs by the builders of private houses.

The diagram (shown in illustration No. 2), explains the arrangement of the pendentives. ABCD is the square room to be covered in. Points are taken in the walls at E, F, G, H, K, L, M and N, so that they form the corners of an octagon. At these points buttresses or piers are built up the walls to carry arches. The latter are then thrown across from one pier to an alternate pier, so that the arches, thus constructed, form, in plan, two intersecting squares E G K M & F H L N and the crowns of all the arches fall upon a circle inscribed within these squares and carry the dome. It will thus be seen that the dome rests directly upon the crowns of the arches, which are always pointed, and the former, being a solid mass of concrete, like a shell, with no loose voussoirs, rests as a dead weight upon the crowns of the arches, conveying no outward thrust to them. The lines joining the intersections and points of the arches, and the corners of the outer square, cut up the space, between the circle and these corners, into a number of concave spherical triangles. These are the "pendentives". (See illustration No. 3)

The combination of the square and the circle played an important part in English architecture of the late 18th century. Fanciful dispositions were developed in all countries during the Renaissance period which prove the desire felt by designers to achieve novelty within certain limits. The circular plan used over a square sub-structure was originally developed by Byzantine dome builders. In such a design as this, the first requirement was to obtain four perfectly stable arches, on which the dome might rest. Accepted in all countries throughout the Renaissance period, this application of geometry to the solution of a structural problem frequently occurs in modern buildings. The dome instead of being placed directly upon the pendentives can now be raised above them upon a cylindrical wall of the required height to admit light.

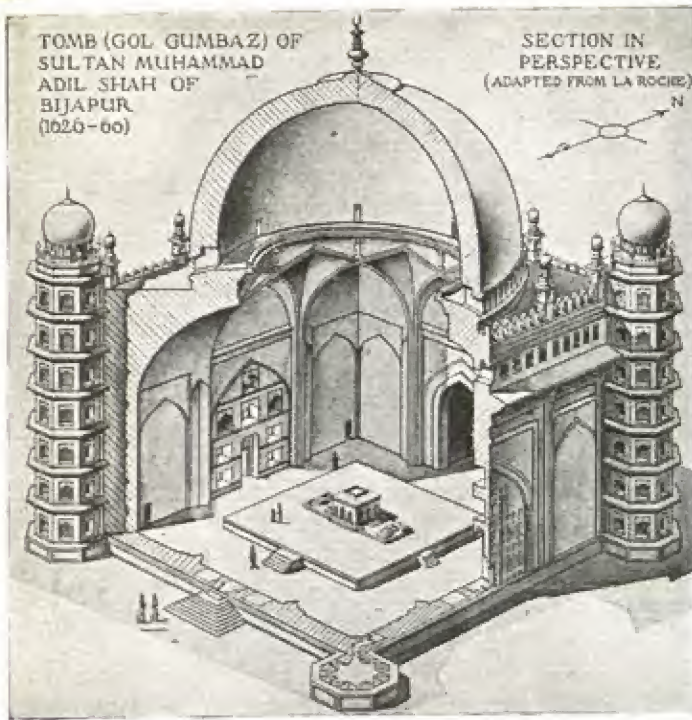


Illustration No. 3

SECTION OF GOL GUMBAZ

● ARCHITECTURAL STYLE :

The architectural period of Bijapur corresponds very nearly with the Renaissance period in Europe.

The architectural buildings of Bijapur comprise mosques, tombs and palaces; the first two classes of buildings predominating.

The architectural history of Bijapur forms a singular contrast with that of Ahmedabad. It would be in vain to look for much Hindu influence in the Mahomedan architecture of Bijapur and in fact nothing at all similar to what is found at Ahmedabad exists in that city.

There are certain characteristics in the fully matured architecture of Bijapur which are predominant. The chief among these is, that all-important feature "the dome", which, is almost spherical in shape and rises out of a band of conventional petals at its base. These forms were repeated to a small scale as an ornamental finish to the turrets. The domes of Bijapur are as a rule, lost internally in their own gloom, they have seldom any clear-storey lights and where they do exist, as in the mosque at Ibrahim Rouza, they are too low. The domes of Ahmedabad are raised above the general roof upon pillars and the light and air are freely admitted.

One device which was perfected and more extensively used at Bijapur in the construction of domes, was the happy idea of the "pendentives" which completely solved their problem of stability in a very graceful and beautiful manner.

Other prominent features are the graceful "minarets" that flank the mosques and rise above the corners of some of the tombs. They are not like the Ahmedabad and Gujerat ones, receptacles leading to galleries round them at different heights.

The typical Bijapur "arch" is of the four-centred variety. Sometimes the arches are, as a rule, two-centred. Sometimes they are struck from a single centre and the curves are carried up from the springing to a point in the haunches, whence tangents are struck to the crown.

The "pillar" is rare in the architecture of Bijapur, its place being taken by substantial masonry piers, usually rectangular in section.

Finally there is the "chajjia" a characteristic architectural ornament, in most buildings, remarkable for its size and projection and for the decorated brackets by which it is supported.

The typical examples which represent the building art in its most significant aspects are the Jami Musjid, one of the earliest monuments to be constructed and therefore the most simple; the Ibrahim Rouza, one of the most elaborate, the Gol Gumbaz showing the style in its most grandiose form and the Mehtar Mahal, depicting it in its miniature and at the same time its most refined and delicate manner.

There is nothing in India which can compare for grandeur of conception with the Gol Gumbaz, nor any so elaborately rich in ornamental detail as the Ibrahim Rouza. The tombs of Humayun and Akbar will not bear comparison with them. Some will no doubt be inclined to think that the Taj Mahal at Agra is superior to anything in the south. The situation of the Taj on the banks of the Jumna surpasses that of any building at Bijapur and it retains its gardens and its range of marble fountains, which every Rouza had, but only very few indeed now possess; all these add immensely to the charming effect of the Taj Mahal, as it now stands. With the same advantages the architect of the Gol Gumbaz would certainly have produced a far grander building, and the architect of the Ibrahim Rouza one more picturesquely magnificent. Indeed, for certain qualities, the buildings at Bijapur stand quite alone among the examples of Saracenic art, and these qualities, rank very high among the art principles.

● HISTORIC MONUMENTS :

It is now proposed to give an account of some of the important historic monuments built during the Adil Shahi dynasty and they are given in the order they were built by each successive ruler. It is most unfortunate, that in a majority of cases, the names of the architects or builders responsible for the design and execution of the buildings are not known.

● JAMI MUSJID :

The real building period of Bijapur did not commence until Ali Adil Shah I ascended the throne. He was a great patron of Art and welcomed artists and craftsmen to his capital. One of the first buildings undertaken was the Jami Musjid (illustration No. 4), which for simplicity of design and impressive grandeur stands unrivalled. It is the largest religious edifice in the Deccan.



Illustration No. 4

JAMI MUSJID

The Jami Musjid, built in 1573, is considered to be the finest example of Bijapur architecture in its more restrained and classical mood and it is the best proportioned building in the city. Unfortunately it was never fully completed. An entrance gateway was provided later by Mughal Emperor Aurangzeb in the 17th century. It is said that every succeeding monarch upto the period of Aurangzeb contributed something to its perfection.

The most beautiful feature, architecturally, of this building is the central dome, which, though less than half the diameter of that covering the tomb of Mahomed, being only 57 feet as compared with 124 feet, is still so elegant in itself. It is also the first example we meet with of that form of pendentive, which is, so far as is now known, peculiar to Bijapur and is perhaps the happiest thought in dome building which has yet come to light. The shape of the dome is segmental and not bulbous as the other domes in the city. The idea of "bud" in the Mahomedan domes is emphasized by a row of petals around the base.

The interior of the Mosque, except the decorated mihrab, is severely plain. The walls and piers are all faced with white plaster. Round the outside of the building runs a deep corridor, and it is mainly the arches of this corridor that break the monotony of the plain walls of the exterior.

The only portion of the Mosque that is richly ornamented, is the "Mihrab" beside which is the marble pulpit. The whole surface of the mihrab is covered with rich gilding upon a coloured back-ground. It shows the richness and variety of the ornamental designs, which are in polished white stucco like marble, and the peculiar beauty of the sentences from the Koran. This splendid specimen of decoration is fortunately still in perfect preservation. The original velvet curtain for the mihrab is still in existence.

The rich decoration of the mihrab was not in the original plan of the mosque. In fact it was carried on by Sultan Mahomed Adil Shah who appeared to have a fondness for coloured decoration. It was he who adorned the walls of the Asar Mahal and decorated the walls of the Sat Majli.

The floor of the Musjid was altered by Emperor Aurangzeb and divided into compartments, each of which was to accommodate one worshipper. They are of white stucco, surrounded by a rim of black. There are 2,250 such compartments.

The massive gold chain which hung from the apex of the dome was taken away by Aurangzeb when the City was captured in 1686.



Illustration No. 5

JANJIRI MOSQUE

● JANJIRI MOSQUE :

The Janjiri Mosque (Illustration No. 5), also known as Malika Jehan Begum's Mosque, was built about 1586, by Ibrahim II.

It is one of the prettiest, exceedingly neat and graceful Mosques in Bijapur, with a good and well proportioned cornice and minarets. The rich facade, the graceful minarets and the fine stucco ornament of the dome are noteworthy. The dome rises over the central bay before the mihrab. Along the top is an ornamental perforated parapet.

There is a tank in front of the mosque. It is dry and empty now as the old water works have not been repaired.

A great deal has been done to this building in the way of repairs and most of the beautiful cornice which had been badly damaged has been restored, together with the portions of the perforated parapet.

● ANDU MUSJID :

This mosque (Illustration No. 6) was built in 1608 by Itbar Khan, one of the ministers of Ibrahim II. It is a two-storeyed building, but not a two-storeyed mosque. The mosque proper is on the upper storey. The ground floor is perhaps a rest-house only. There is a terrace in front of the mosque. The reason for placing this mosque upon the second storey is not quite apparent; it was perhaps a whim and nothing else. The ground floor is severely plain and the general appearance is greatly enhanced by the numerous offsets and recesses.



Illustration No. 6

ANDU MUSJID

The mosque is about the best built of any in Bijapur. The surface of the stones is all but polished, having probably been rubbed down with sand and water so as to efface all tool marks. The joints of the masonry are so fine that the edge of a sheet of note paper could barely be inserted between them. The front seems not to have been quite finished, the two large lower brackets under the cornice, one on the face of each pier, have not been inserted, but the corbels and slots have been made for them. A beautiful perforated parapet runs along the top of the building.

The principal dome and the smaller bulbs of the minarets are of the "ribbed melon shape" variety and so it is called the Andu or the egg-shaped Musjid. This feature is rare in Bijapur and occurs only in two or three buildings. That the masonry has stood the weather for more than 300 years is a certificate in itself.



Illustration No. 7

TAJ BAURI

● TAJ BAURI :

The building and the tank (Illustration No. 7) were built by Malik Sandal in 1620, in honour of Taj Sultana, the queen of Ibrahim II. The facade of the building, with its fine archway of 35 feet span, and centre minarets, though incomplete in one part, is extremely handsome. The apartments in the front portion of the building are spacious and comfortable, well lighted by perforated stone windows. The interior room is the most elegant of all, with a groined roof and pendentives in the corners, which support a dome, now in ruinous condition. There is no doubt that the whole building was intended as a caravanserai for travellers and visitors.

This is the biggest and largest and most finely built tank in Bijapur. The tank is square in shape, each side measuring 223 feet and has a depth of about 52 feet in the centre. It was excavated from the basaltic trap rock. It is enclosed within high walls. Descending the broad flight of steps, and going through the great entrance arch, we come to the landing, leading with steps, to the water on both sides.

The tank is fed by under-ground water. In days when Bijapur had no water-works, it was this tank which supplied water to one-fourth of the town in times of water scarcity. Above the sides of the tank are arrangements for raising water, those on the south being still used to irrigate the gardens behind.

The east wing of the Taj Bawri in front including the domical roof, is not in existence to-day, except the end bay. There is, therefore, a good scope for the student of architecture to restore this structure.

● MEHTAR MAHAL :

The Mehtar Mahal (Illustration No. 8) is a perfect little gem of Bijapur architecture probably built in the reign of Mahomed Adil Shah. Although styled a 'Mahal,' it is

in fact a gateway to the inner courtyard of a mosque. It has upper rooms and balconies above the entrance from which people in olden times must have enjoyed a fine view of the royal capital.

The general outline of the Mehtar Mahal is a tall square tower with two slender minarets rising to a height of 66 feet. The architecture of the building resembles that of the Andu Musjid and the Janjiri Mosque. The old wooden doorway with its massive framing and curious iron bosses and nail heads is worth inspection. The most striking features of this building are the "balcony-windows". For pure gracefulness and delicacy of treatment, there is nothing to surpass them in Bijapur. Along the top of the building ran the beautiful lacelike parapet nearly the whole of which has been restored. It is on this portion of the building that the decorative skill of the artists has been so richly lavished. The ornaments of the cornices, brackets and mouldings, with the perforated brackets which support the eaves, over the windows, are beyond any question, the most perfect specimens of the art of stone-cutting in Bijapur and can only be appreciated by examination of the details.

To the student of architecture the most interesting peculiarity in the building is the essentially wooden character of the decoration. Though it is difficult not to feel the want of appropriateness to "stone architecture" in the details of the Mehtar Mahal, it is impossible not to be struck with the extreme delicacy of finish and the general beauty of the forms.

The stone used in this building was not the basaltic trap of the locality. It is the laminar limestone found near Talikota, about 30 miles from Bijapur.

The most noteworthy thing here is the very curiously arranged ceiling of the entrance hall. This, as well as the ceiling of the upper floor, is constructed in the same manner as that at the Ibrahim Rouza.

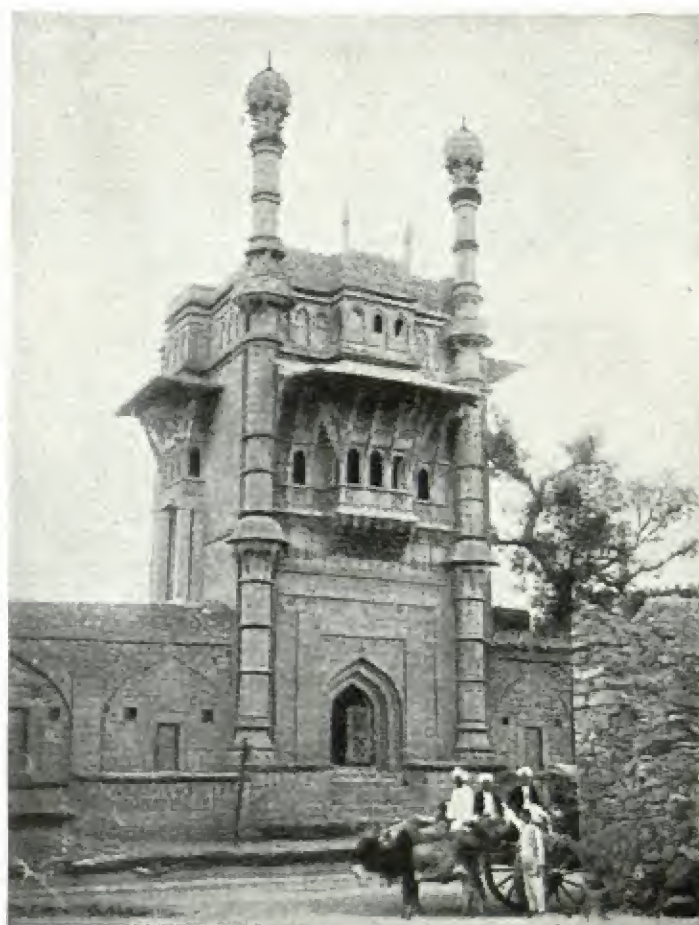


Illustration No. 8

MEHTAR MAHAL

The story that it was built by a Mehtar, that is, a sweeper or Bhangi deserves little credit. In fact the building has no connections with a sweeper. The Mahomedan priests (mullas) appointed a head amongst themselves. He was called a Mehtar. One Gadai, a mehtar, had accompanied Ali I on his visit to Vijayanagar. Ali received many presents there and he is said to have given them to the Mehtar. With this money Gadai built a Mosque and a gateway. The gateway now is called the Mehtar Mahal or Bhangi Mahal, the latter being a pure misnomer.



Illustration No. 9

IBRAHIM ROUZA

● IBRAHIM ROUZA :

Ibrahim Rouza (Illustration No. 9) forms a group of buildings which includes the tomb proper and the mosque, as also their gateways and their terraces. It is said to have been built by Malik Sandal in the year 1626. At one time, this lovely tomb was surrounded by a beautiful garden with rills of water running through it.

But what strikes the visitor of this tomb most is the amazing wealth of decoration to be found on the exterior walls of the sepulchral chamber and the doors and the ceiling of the corridor that surrounds the chamber. The decoration chiefly consists of "shallow surface tracery" and interlaced writings from the Holy Koran. It is said that the whole text of the Koran has thus been transcribed on these walls. The windows are beautiful specimens of perforated stonework interlaced with Arabic writing. The doors of these walls are of teak, divided into carved panels, containing the words, "Allah is one", "Allah is present", "My helper is Allah". The pillars in the corridors are very Hindu in style and have little that is Saracenic about them.

The deep rich cornices, the graceful minarets, the perforated parapets and the miniature minars round the bases of the corner minarets all go to show that the labour expended and the art manifested has been unstinted. Under the cornice of the mosque may be seen the remnants of heavy chains with pendants. Each of these has been carved out of a single block of stone.

Here again we are met by the fact that the cornices, which form the richest part of the external decorations, are copied from wooden originals, not so directly as in the Mehtar Mahal, but still the forms are such as could not be invented in stone.

In this building we are introduced for the first time to a new feature in Mahomedan Architecture by the introduction of a tall dome employed as an external ornament. It was afterwards employed in the Taj Mahal at Agra, and became fashionable with the bulbous form of dome both in India and Persia. The Pantheon at Rome, St. Sophia at Constantinople and generally all the earliest and the best Byzantine domes, fail in effect externally, exactly in proportion to their success internally. Their builders considered the interior the more important part of their edifices and

took no pains to render the external forms of their buildings beautiful. When the Renaissance architects in the 15th Century attempted the problem, they tried to emulate the tall forms of Gothic Architecture and ran into opposite extremes. In St. Peter's and St. Paul's, beauty of external form is what their architects were aiming at. The interior is made too lofty for its other dimensions and thus becomes generally very destructive of the proper proportions of the rest of the building. The Saracenic architects in Egypt, Persia and India, came nearer to a happy proportion between these two elements than was ever accomplished in Europe.

● GOL GUMBAZ :

Gol Gumbaz (Illustration No. 10) is the mausoleum of King Sultan Mahomed Adil Shah. It was built in the year 1656 and is one of the finest structural triumphs of the Indian builders. This magnificent mausoleum, with its gigantic dome and renowned whispering gallery, has been a source of attraction to visitors from all parts of the world.

The general appearance of the building is that of a great cube surmounted by a large hemispherical dome with an octagonal tower at each of the four corners of the cube. If the octagonal towers are left off, then the building consists of only one great compartment covered by a dome. The building rests on a foundation of solid rock.

The most notable architectural feature of Gol Gumbaz is the massive cornice which runs round the building and projects 11'-6" from the wall. One curious thing to be observed above the entrance gate is a "meteoric", popularly known as Bijli Pattar (the lightning stone) which is said to have fallen in the vicinity during Muhammad's reign. The stairways leading to the roof, as in most of Bijapur mosques, are in the thickness of the end walls. In this, they differ very much from the Ahmedabad buildings, where the stair is a spiral passage winding up through the minarets.

The architect of the Gol Gumbaz aimed at producing the most mechanically imposing building which he was capable of conceiving. He proposed to surpass all other tombs in mechanical grandeur just as the designer of the Ibrahim Rouza had wished to excel in artistic ornamentation. The architect who conceived and carried out the very stupendous task of hanging a mighty dome right across the whole expanse of the outer walls, has indeed executed a remarkable feat.

The condition of the dome was very alarming some years ago, as serious cracks, due to several causes, had developed on the extrados of the dome, some of them being two feet wide. Before the last World War, the whole dome was re-conditioned by the application of "Gunite" at a considerable cost.

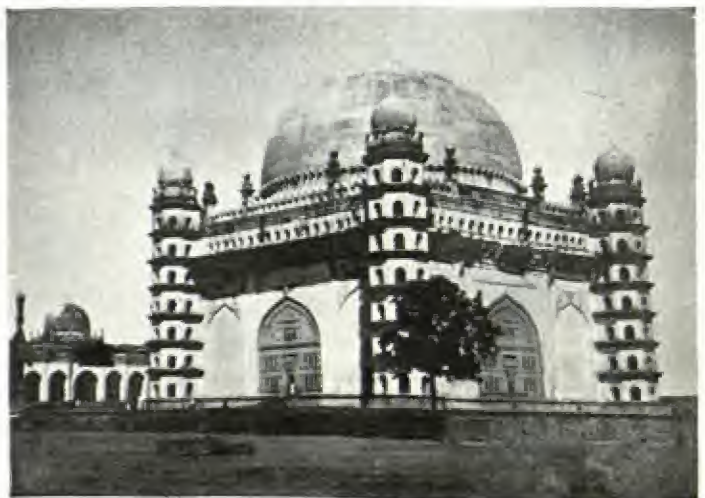


Illustration No. 10

GOL GUMBAZ

The dome of the Gol Gumbaz, one of the largest existing hemispherical domes of masonry, has an inside diameter of 124 feet 5 inches and is carried on pendentives over a hall 135 feet 5 inches square, the thickness of the shell is about 9 feet at the summit and 10 feet at the springing. The extreme height to the apex of the dome from the base of the building is 198 feet 6 inches. At its springing level, the dome houses the famous whispering gallery, 11 feet wide, which hangs out into the interior of the building, 109 feet 6 inches above the floor. Above the floor of the gallery, the wall is approximately vertical for a height of about 10 feet. The dome around the gallery is perforated with eight open doorways.

A close inspection of the inside of the dome, wherever it was exposed, showed that the bricks are laid on flat in lime mortar and the thickness of the joint varies from 1" to 2" at places. The bricks are of varying size and do not appear to be very systematically laid.

The accompanying table gives a comparison between the mechanical excellence of the Gol Gumbaz and other celebrated examples.

	Form at base.	Internal Dia. feet.	Height Internally feet.
The Pantheon at Rome	..Round	142	146
St. Peter's at Rome	..Round	137	333
Gol Gumbaz, Bijapur	..Square	135	175
St. Paul's, London	..Round	108	220
St. Sophia, Constantinople	Square	107	182
Taj Mahal, Agra	..Octagon	58	80

The most popular feature of Gol Gumbaz that has attracted tourists from all parts of the world is its Whispering Gallery. On entering the gallery one is struck with the loud echoes that fill the place in answer to the footfall. Loud laughter is answered by a score of fiends. The slightest whisper is heard from side to side at a distance of 124 feet and a single loud clap is distinctly echoed 14 times.

(A detailed account of the Gol Gumbaz, relating to the Whispering Gallery, Acoustical Investigation, Laboratory tests of plaster and extermination of sparrows, written by the author of this article, appeared in the October 1946 issue of the "Journal of the Indian Institute of Architects.")

● SAT MAZLI :

The Sat Mazli, known as the Palace of Seven Storeys (Illustration No. 11), was built by Sultan Mahomed Adil Shah for the residence of his favourite mistress, Rhumba. Although a good deal ruined, enough remains to render its plan and appearance intelligible. Like all the palaces in the citadel, it depends on stucco, covered with gilding and colour, for its ornamentation. The building stands high above all other palatial ruins and in design as well as details is an extremely good specimen of Deccan Mahomedan Architecture. The height of the building as it stands now is 97 feet. The height suggests that it must have served the purpose of a glorified royal watch-tower for the kings of Bijapur in those eventful times. At present there are only five storeys remaining and the other two storeys have disappeared.

From the top of Sat Mazli a fine uninterrupted view of the city on all sides can be obtained. It is by no means a handsome looking building today. The building would seem to have been erected as a pleasure house wherein to spend an idle hour and from the higher storeys of which to sit and watch what might be going on in the City or in the country around.

The characteristic feature of this building is the number of water-pipes and bath cisterns found in every possible part of the building including the walls. The cooling effect of water was well appreciated and made use of by the kings. From this it is clear that Sat Mazli was meant for pleasure and royal baths.

The walls were covered with paintings but there is no trace of these at present. It is said that the walls were also richly and beautifully gilded, but they were later scraped off by the orders of the Raja of Satara. The rich and beautifully carved woodwork which Sat Mazli once possessed, was also removed.



Illustration No. 11

SAT MAZLI

● ASHAR MAHAL :

The Ashar Mahal (Illustration No. 12) was built in 1646 by Sultan Mahomed Adil Shah.

It is a great open building, the front part being an open hall supported by wooden pillars. It consists of a ground floor and a storey above, in which are the principal apartments. The front verandah, 120 feet long and 33 feet broad, runs the whole length of the building. The tall pillars of the front are massive teak pillars of 35 feet in length and 4 feet dia. at base, dressed into an octagonal form. The woodwork of this verandah and generally of the whole palace, the fittings of the windows, and their carved brackets show that the carpenters of Bijapur were in no degree inferior to the stone-masons of the same period.

It was originally meant to be the Hall of Justice. It was known as 'gilded hall' on account of its ceiling of panelled wood having been covered with gold-leaf and the fine ceiling is worth noting. It was here that Mahomed sat upon his elevated seat and administered justice.



Illustration No. 12

ASHAR MAHAL

● SISTER DOMES :

The domes of the tombs are exactly alike and adjoin each other ; so they are known as sister-domes or twin-domes (illustration No. 13). The octagonal building on the south is the resting-place of Khan Muhammad and his son Kharvas Khan. In the tomb of Khan Muhammad is one of the finest and spacious halls in Bijapur. Below the hall, are the vaults where the real graves are.

The larger square tomb is that of Abdul Rezak Qadir and was, no doubt, built at the same time as the other. The tomb is very plain.

Like the Gol Gumbaz these two tombs have galleries inside the domes, but as they are small, they have no distinct echo.

The floors of both tombs are at a very considerable elevation above the surrounding ground level, which is due to the vaults, containing the graves, being built upon the ground rather than beneath its surface, as is the case in most tombs.



Illustration No. 13

SISTER DOMES

● UNFINISHED TOMB OF ALI II :

This last and unfinished royal tomb (illustration No. 14), lies a few yards from the Traveller's Bungalow. The tomb is now popularly known as Bara Kaman. The great elevated basement on which the great tomb was to stand is 215 ft. square, while that of Gol Gumbaz is 158 ft. square, and hence would have covered the greatest area of any building in Bijapur.

The most peculiar characteristics of the building are its arches. They are purely Gothic in outline, having been struck from two centres, the curves being carried up to the crowns. The form of arch otherwise universal in Bijapur, is that where the curves, struck from two centres, and rising from their springing, at a certain point, tangents to the curves which continue the archway to the crown. This departure from the usual type gives the building rather the appearance of an old Gothic ruin, and these rings which remain to this day, have regular voussoirs and keystones.

Although the tomb was unfinished, Ali was buried within the building, his grave being represented by the great tombstone on the central platform.

It is unfinished, however, like many tombs in the east, and as must too often be the case where kings undertake the erection of their own sepulchres. The Egyptians, with their usual practical sense, seem alone among the tomb-building races, to have solved the problem. In that country the king went on adding chamber to chamber, burrowing deeper and deeper into the hillside, till death arrested his career and the progress of his last resting-place. But the tomb was complete with the first chambers, the extension merely shadowed forth the length of his reign and splendour

of his kingdom. With a structural building this is not so easy. A tomb must be square or polygonal in plan. It must be set out symmetrically around a central point. If on too large a scale to be finished before the king's death, like this one of Ali II, he leaves only a ruin.

The whole surface of the massive masonry has been left rough for a subsequent coating of plaster. The building is a standing lesson to the present-day masons. The rough-looking stones are so ingeniously joined and with the least quantity of mortar that on seeing the structure one can't help but say—"our forefathers were great builders."

● CONCLUSION :

From the account given above one would come to the conclusion that the architecture of Bijapur had its own peculiar characteristics and it is now upto the young architect to incorporate in his designs these essentials to suit modern conditions.

At present there is a "Modernistic" spirit prevalent among students and practising architects throughout India. I feel, that traditional architecture should be taught as thoroughly as planning and construction in order to give the student, at the end of his training, a solid foundation on which to work, whether he decides for "tradition" or "modernism" or both.

The intelligent restoration of historic buildings can only be safely entrusted to those who are genuinely in sympathy with the great architecture of the past.

I am of opinion that the teaching and practice of the subject of architectural design should be sufficiently conducive to encourage good Indian traditions and to evolve a style characteristically Indian in due course of time.



Illustration No. 14

UNFINISHED TOMB OF ALI II

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THE GOL GUMBAZ AT BIJAPUR

- *Whispering Gallery*
- *Acoustical Investigation*
- *Laboratory Tests of Plaster*
- *Extermination of Sparrows*

By

Mr. S. S. REUBEN, F.R.I.B.A., F.I.I.A.,

Assistant Professor of Architecture, Sir J. J. School of Art, Bombay.

THE GOL GUMBAZ AT BIJAPUR

• *Whispering Gallery* • *Acoustical Investigation* • *Laboratory Tests of Plaster* • *Extermination of Sparrows*

by

Mr. S. S. REUBEN, F.R.I.B.A., F.I.I.A.,

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GOL Gumbaz, the ancient historic monument, is the mausoleum of King Sultan Muhammad Adil Shah, one of the Bijapur kings who reigned from 1626 to 1656. Today this well-known and famous edifice is the pride of India. It was built in the year 1656 A.D. and is one of the finest structural triumphs of the Indian builders, built with local materials obtained from the surrounding districts. This magnificent mausoleum, with its gigantic dome and the renowned whispering gallery, has been a source of attraction to visitors, not only from all over India but also from the distant parts of the world.

It was the ruling passion of the Mohamedan kings of the Adilshahi dynasty (1489-1686) to build a memorial or an architectural monument in their lifetime, for their remains after death, which has been the main cause of these exquisite and grand works of art. The architectural buildings of Bijapur comprise mosques, tombs and palaces, the first two classes of buildings predominating. The famous buildings have now come under the care of the Department of Archaeology and today the chief monuments of the city present a neat and well protected appearance.

The architect of the Gol Gumbaz aimed at producing the most mechanically imposing building which he was capable of conceiving. He proposed to surpass all other tombs in mechanical grandeur just as the designer of the Ibrahim Ruza had wished to excel in artistic ornamentation. The system of pendentives, which is famous in India, is, without doubt, the most successful and most graceful method of construction of domes. The architect who conceived and carried out the very stupendous task of hanging a mighty dome right across the whole expanse of the outer walls, has indeed executed a remarkable feat. But it is most unfortunate that his very name is now unknown.

The dome of the Gol Gumbaz, one of the largest existing hemispherical domes of masonry, has an inside diameter of 124 feet 5 inches and is carried on pendentives over a hall 135 feet 5 inches square, measured internally. The thickness of the shell is about 9 feet at the summit and 10 feet at the springing. The extreme height to the apex of the dome from the base of the building is 198 feet 6 inches. At its springing level, the dome houses the famous whispering gallery, 11 feet wide, which hangs out into the interior of the building, 109 feet 6 inches above the floor. Above the floor of the gallery the wall is approximately vertical for a height of about 10 feet. The dome around the gallery is perforated with eight open doorways.

The building most resembling the Gol Gumbaz is the Pantheon at Rome. The Pantheon is a circular building, the diameter of which is 142 feet, its area being 15,833 square feet. The tomb of Muhammad is square, each side being 135 feet; its area, therefore, is 18,225 square feet, that is, more than one-eighth in excess. The construction of the Roman dome on a circular drum is simple and easy. That of the Indian tomb, having to be worked up from a square, was one of the most difficult problems that could be proposed to an architect and must have involved engineering skill of the highest order.

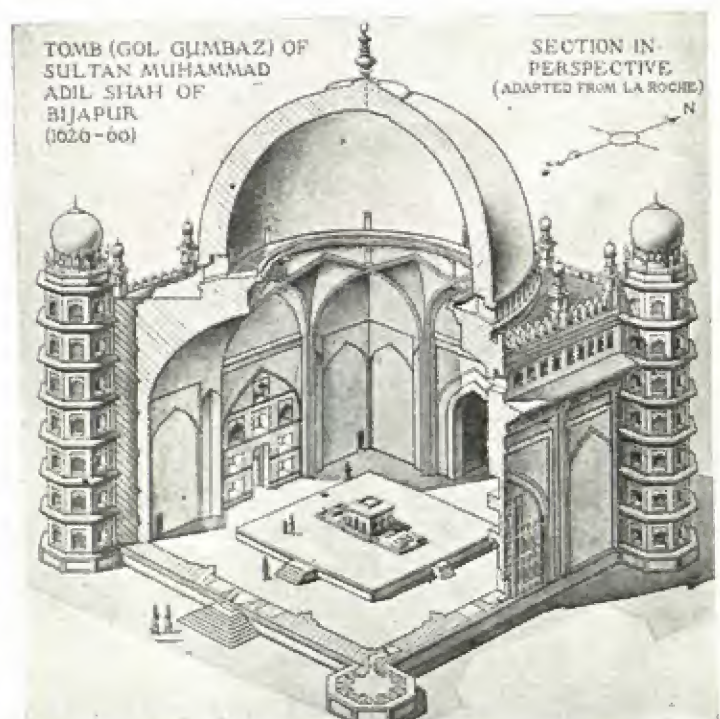
The Gol Gumbaz possesses wonderful acoustic properties, which could be classified as follows:—

- (1) A longer time of Reverberation Period.
- (2) The Phenomenon of Multiple Echoes.
- (3) The Whispering Gallery effect.

• WHISPERING GALLERY :

The most popular feature of the Gol Gumbaz that has attracted tourists from all parts of the country is its Whispering Gallery. By the term "Whispering Gallery" is usually understood a building or a room either artificial or natural in which faint sounds can be heard across extraordinary distances. In the Gallery of the Gol Gumbaz benches are provided at four places at equal distances in the gallery and they are very close to the wall. When a person, sitting on one bench, whispers near the wall, he can be heard at any point on the circumference. But the effect is most pronounced when the speaker and the hearer are at the opposite ends of a diameter. Under ordinary conditions a whisper is hardly audible at a distance of a few feet.

On entering the gallery one is struck with the loud echoes that fill the place in answer to his footfall. Loud laughter is answered by a score of fiends. The slightest whisper is heard from side to side at a distance of 124 feet and a single loud clap is echoed 14 times distinctly. Other instances of multiple echoes are the famous dome of the Pantheon at Rome and the Whispering Gallery of St. Paul's, London. This phenomenon of multiple echoes was not deliberately planned, but is the natural result of the huge size of the dome. It requires more than 65 feet between a person and the reflecting surface, in order that the sound of the voice may, on return, reach his ear, after the cessation of the original sound, to create the impression of a second sound or echo. If a greater distance intervenes, the echo is more distinct, as more time separates the original from the reflected sound. If the distance is less no distinct echoes result, as the original and reflected sounds overlap and produce a confound-sound or resonance. In the smaller domes we get what is called resonance, their diameter not being sufficiently great to allow of a distinct echo.



FROM INDIAN ARCHITECTURE

by Percy Brown



THE GOL GUMBAZ

Photo: B. M. Billimoria

● ACOUSTICAL INVESTIGATION :

The observations made and the results of the Aconstical Tests carried out at the Gol Gumbaz by the writer in the presence of the members of the Annual Study Excursion Party of the Sir J. J. School of Art, Bombay, at Bijapur are recorded below :—

Date : 24th October 1945.

Place : The Gol Gumbaz, Bijapur.

Time of Investigation : 8 A.M.—10-0 A.M.(I.S.T.).

Source :	Reverberation in Seconds :		
	(by stop-watch)		
	1st stage.	2nd stage.	3rd stage.
1. MOTOR CAR HORN ..	14½	13½	14
2. BUGLE ..	14½	15	15½
3. SUSTAINED SHOUT ..	12	12½	11½
4. LOUD SPEECH ..	11	11	11½
5. PISTOL SHOTS ..	14	13½	13½
6. MEGAPHONE ..	10½	11	11½
7. BEATING A TURBAN CLOTH on the parapet of gallery ..	13	14	14
8. TURBAN CLOTH BALL thrown on the floor below from the gallery (height 109'-6")	13	13½	13½

		<i>Number of Echoes :</i>		
1.	FALL OF FOOTSTEP	5	6	7
2.	ORDINARY SPEECH	2	3	3
3.	HANDCLAP	12	12	12
		clear and then fading.		
4.	HANDCLAP (repeated)	14 clear, and 3 fading.		
5.	METRONOME ..	5	5	5
		(low)	(medium)	(high)

Other Observations :

1. Dropping a coin	} All these sounds were clearly heard at a distance of 124'-0".
2. Lighting a match	
3. Tearing a paper	
4. Dropping a match-box	
5. Whisper	Was very clear.
6. Pin dropping	Not heard.
7. Tick of alarm clock	Not heard.
8. Mattress above speaker	Hearing conditions were somewhat poor

It may be mentioned here that in previous years the acoustical properties of the Gol Gumbaz have been investigated by two leading scientists of Bombay : Principal H. J. Taylor and Principal G. R. Paranjpe, who have both conducted experimental measurements inside the Gol Gumbaz ; but so far no practising Architect or Engineer in India has taken the initiative. The experiments carried out by the latter have enabled a regular gramophone record to be made wherein the number of the echoes can be accurately counted and which have been registered by a Sound Recorder.

It is difficult to say whether the effects observable today are as good or better or worse than they were some years ago. It was found that at present the acoustic properties of the dome have been impaired owing to the uneven inner surface of the dome, due to the dropping of plaster at several places. On superficial examination it is found that approximately 300-400 square feet of plaster from the soffit of the dome has already fallen out. This is chiefly due to the damage done to the plaster by the sparrows housed in the building crevices and partly due to the vibration caused to the building owing to the location of the railway lines nearby. Further deterioration in the acoustical properties will occur if this state of affairs is allowed to continue and is neglected for some time more. It is therefore absolutely necessary to take immediate steps to improve the acoustic properties of this dome by replastering the whole inner surface of the dome with a smooth and hard plaster, preferably Victorite plaster.

If this important work of replastering the inside of the dome is undertaken it will involve not only heavy expenditure but will call for engineering skill of the highest order, particularly in the construction of a scaffolding to this great height.

● LABORATORY TESTS OF PLASTER :

A sample of plaster slab which had fallen from the inner surface of the dome of Gol Gumbaz has been tested by the College of Engineering, Poona. The results of the Laboratory Tests in respect of the Chemical Analysis of the plaster slab are given below :—

CHEMICAL ANALYSIS

1. Insoluble residue containing sand grains of various sizes	13.85%
2. $\text{Fe}_2\text{O}_3\text{Al}_2\text{O}_3$	11.19%
3. CaO	38.43%
4. CO_2	30.19%
5. SO_4	5.76%
6. MgO	A trace
7. Alkalies, moisture by difference	0.58%
	100.00

From the above results it will be observed that the plaster is composed of lime and sand in the proportion of 3 : 1 approximately.

● EXTERMINATION OF SPARROWS :

During the experiments it was noticed that there was some disturbance caused on account of the presence of the sparrows who were sending their own notes. These sparrows are housed in the plaster crevices of the dome and their presence is detrimental to the acoustic properties of the dome as they have already damaged portions of plaster causing collapse at some places from time to time, and further, they have been found to be a nuisance in the Whispering Gallery, thereby marring the excellent whispering effect.

The following two remedies are suggested, which will drive them away completely from the building :

- (1) To use tear gas with the help of a foot-pump ; it should be distributed at several points in the gallery so that the distribution may be uniform.
- (2) To burn sulphur in the form of powder or sticks for a few hours, preferably at a higher level, on a platform 10'-0" to 15'-0" above the level of the gallery and uniformly distributed at several points in the gallery.

The above two experiments will completely drive away the sparrows from the building and will probably kill some of them during the experiments. It is very likely that they will return after a few weeks but their entry could be prevented by filling in the panels of the eight doors in the Gallery

with wire-netting or some jali of a small mesh or by providing flush panelled swing doors.

It is very essential that the work of extermination of the sparrows should be taken in hand immediately so that it may not result in further deterioration of the acoustical properties.

I take this opportunity of expressing my sincere thanks to Principal H. J. Taylor of the Wilson College, and Principal G. R. Paranjpe of the Royal Institute of Science, Bombay, who were extremely kind to grant me interviews at their respective colleges, to discuss points relating to the acoustics of the Gol Gumbaz prior to my carrying out the acoustical tests and after. I have also to thank Mr. Q. M. Moneer, Superintendent, Archaeological Survey of India, Western Circle, Poona, and his assistants, who heartily rendered assistance to the members of the Annual Study Excursion Party at Bijapur, and enabled them to make their mission to this historic town a success.



THE ARCHITECTURE OF BIJAPUR + Gal Gombier

By S. S. REUBEN, F.R.I.B.A., F.I.I.A.,

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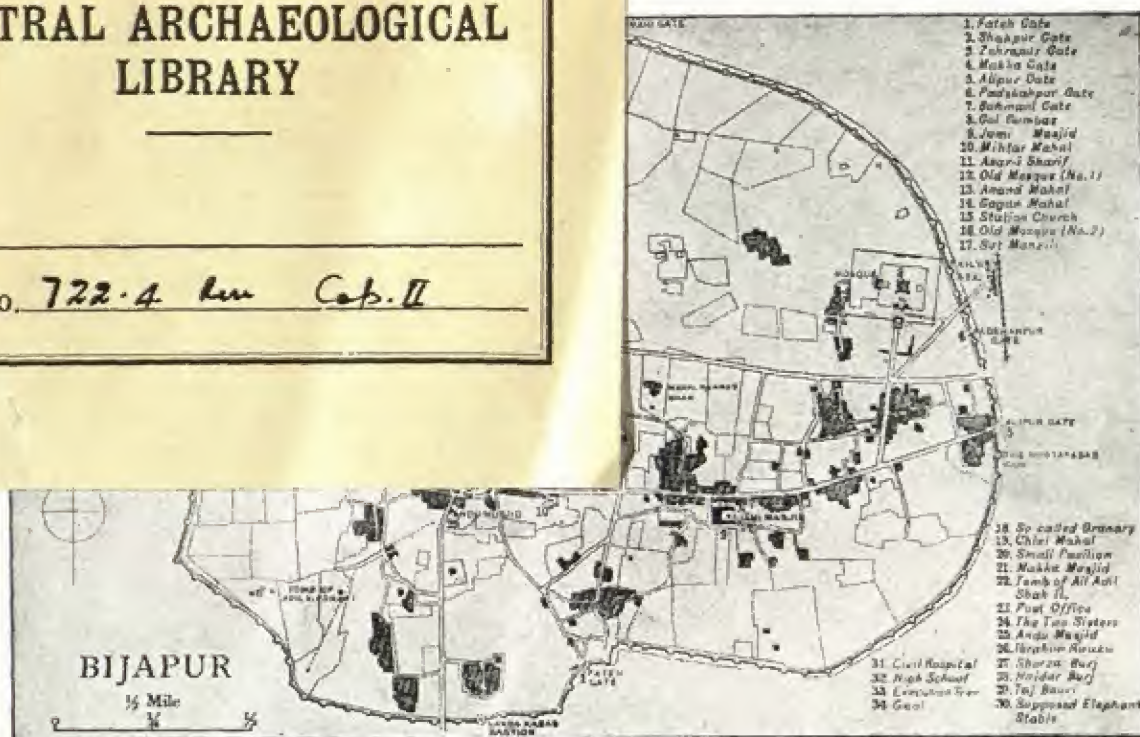


Illustration No. 1

LAYOUT

BIJAPUR, once the capital of the Deccan, is situated about 350 miles to the south-east of Bombay. A tourist from Bombay travels on the G.I.P. Railway main line from Bombay to Madras and gets down at Hotgi Junction, which is on the 292nd mile stone. From here the metre-gauge line of the Southern Mahratta Railway brings him, after a short distance of 58 miles, to the City of Bijapur.

The town is situated in north latitude $16^{\circ}50'$ and east longitude $75^{\circ}52'$, at an elevation of 2,000 feet above sea-level. It is surrounded, for the most part, by long stretches of dry, barren, stony soil, treeless plains, with little vegetation and due to the geological condition of the soil, the town has no "landscape setting" from the point of view of landscape architecture.

● HISTORICAL OUTLINE :

The Adil Shahi dynasty was established in the year 1489, by Yusuf Adil Shah, and made Bijapur their capital where they ruled from 1489 to 1686.

A chronological table of the Adil Shahi dynasty of Bijapur is given below :—

Yusuf Adil Shah	(1489-1510)
Ismail Adil Shah	(1510-1534)
Ibrahim I Adil Shah	(1534-1557)
Ali I Adil Shah	(1557-1580)
Ibrahim II Adil Shah	(1580-1626)
Muhammad Adil Shah	(1626-1656)
Ali II Adil Shah	(1656-1672)
Shikandar Adil Shah	(1672-1686)

The above reigns of the kings of Bijapur correspond very nearly with the reigns of the kings of England, on the British throne, that is from Richard III (1483) to James II (1685).

The Adil Shahis were at constant wars with the Hindu kingdom of Vijayanagar for supremacy. For nearly half a century they had to fight with Vijayanagar till it was overthrown at the battle of Talikota in 1565.

The early kings of the Adil Shahi dynasty were too much occupied by wars and the struggle for existence was too severe to admit of much leisure for indulgence in the luxury of art. Yusuf Adil Shah and his two successors followed the usual practice in India in using Hindu craftsmen and building mosques and tombs with the materials of the Hindu temples they destroyed. It was not until the time of Ali Adil Shah I that Bijapur developed a characteristic building tradition of its own, which was grafted upon the older Hindu traditions but adapted to Mahomedan ritual. It is in this period that we really enter on the great building epoch of the city: all the great monuments being crowded into the 100 years that remained before the wars of Aurangzeb put an end to the glory of Bijapur, in the middle of the seventeenth century. In a political sense, Bijapur ceased to exist after its capture by the Emperor Aurangzeb.

It was the ruling passion of the Mahomedan kings, to build a monument or a memorial for their remains after death, which has been the main cause of these exquisite and grand works of art. It is therefore necessary that we should know the history of the dynasty whose love of architecture manifests itself in every building of Bijapur.

Every king built a tomb for himself during his life time and if he died prematurely his tomb was left unfinished because his successor was too busy erecting his own tomb, and each succeeding king tried to make his tomb more monumental than that of his predecessor.

Since the fall of the Adil Shahis, Bijapur passed from hand to hand, from Peshwas to the king of Satara, till finally with the end of Satara, it reverted to the British. On 17th May, 1818, Bijapur became the possession of the British.

The historic monuments have now come under the care of the Department of Archaeology and to-day the chief monuments of the city present a neat and well protected appearance.

● OLD BIJAPUR CITY :

Building operations on this site (see layout in illustration No. 1) began during the latter half of the 15th century. The construction of the walls of the citadel, a fortress irregularly circular in plan and containing a palace and imperial buildings, was begun by Yusuf Adil Shah in 1489 and were continued by his successors upto the reign of Ali Adil Shah I who died in 1579. As the power of the Adil Shahis increased, around the citadel a city was gradually formed, and in the course of time was enclosed within strongly fortified walls. The trace of these city walls is also an irregular circle and from the citadel in the centre roads radiate to the five principal gates.

The area of the whole city covers about $2\frac{1}{2}$ square miles and the walls and the fortifications that surrounded the city had a circuit of about $6\frac{1}{2}$ miles. The city walls have five principal gates.

- (1) The Mekka Gate on the West.
- (2) The Shahapur Gate at the North-West corner.
- (3) The Behamani Gate on the North.
- (4) The Allapur Gate on the east.
- (5) The Fateh Gate on the south-east.

Besides these, there are smaller ones also. The walls have been built of stone and mortar and the space between the outer and the inner wall being well rammed up with earth. Outside the walls and running nearly the whole length is a deep broad moat.

No Mahomedan city could be without an abundance of gardens. An ample and regular water supply was hence the prime necessity. The Bijapur kings were lovers of gardens and they have constructed water-works which were perfect in their time.

Abundant and wholesome water was supplied to the entire city and its innumerable gardens from the two principal sources, one from Torwee, four miles to the west and the other from Begum Talao to the south. From Torwee a great underground tunnel carried the water to the city. The direction of this underground tunnel can be easily traced by the stone air shafts built at regular intervals along the route. The water from Begum Talao was brought in earthenware pipes, specimens of which could be seen by the visitor in the Archaeological Museum attached to the Gol Gumbaz.

Besides these outside sources, the city had innumerable wells and tanks. The most important of these being Taj Bauri and the Chand Bauri. The Mahals of Adil Shahs and those of the chief noblemen had innumerable fountains, running water, spouts, and clever devices to carry water on every floor and thus produce a cooling effect in the hot days of scorching and dry summer.

● TOWN PLANNING :

The characteristic features which distinguish the towns of ancient India from the present day cities are their strong fortifications. Exactly in a similar way were the ancient Greek and Roman towns fortified by walls.

The layout of Bijapur (shown in illustration No. 1) shows that the principles of town-planning were observed by the town-planners even in those olden times in view of the fact that the citadel, containing the palaces and imperial buildings, was well anchored as a dominant feature of the layout with a ring road around it and roads radiating from this central place, terminating at the city gates. The latent defect in the layout of this historic town is, that the historic monuments are scattered all over regardless of the positions of the roads,

and that there is no proper vista leading to a focal point, such as a historic monument. Further, the roads leading to the city gates follow no direct alignment, nor does there seem to have been any serious attempt at systematic town-planning.

The location of the old water-works and reservoir influenced the siting of this city and led to its development and the city even to-day is inhabited owing to the geographical inertia of the population.

The civic centre was well co-ordinated in relation to the other part of the city and was a good example of "neighbourhood planning" but this layout would not suit the modern needs of to-day.

The ancient town-planning indicated the "diagnostic approach" to the problem and not the "cosmetic approach".

As a preliminary to the planning of a town, the town-planner must take a historical and sociological survey of the site. It would be a sheer disregard if he did not respect the ancient historical relics of the place, if he pulled down and demolished everything that stood in the way of successful execution of his fanciful scheme and left no trace of the past.

The town-planners will certainly fail in their duty if they narrow down their attention only to the construction of the city without any regard for the best arteries of its communication with the outer world and a good "regional plan" should be envisaged, ultimately developing into a "National plan".

While re-planning this town condition of "blight" should be eliminated and fewer houses to the acre, should be constructed.

To the student of Architecture and Town-Planning there is an ample scope for preparing plans of this historic town and re-creation, based on careful study of the existing remains and of the historical data.

● LOCAL MATERIALS :

The builders at Bijapur were greatly handicapped by the limited area from which they were able to draw their material which was necessarily contained within the confines of the state.

Most of the buildings of Bijapur are faced by, and largely constructed, of stone—a local basaltic trap, which underlying the shallow surface soil, was quarried on the spot without difficulty. It is of a very fine grain and remarkably tough consistency, not too hard to work and probably growing harder by exposure. It is of a rich brown or greyish brown colour, takes a high polish and is susceptible of as high and perfect finish as marble. Palaces, tombs, gateways and minarets were all carved from this rich brown basalt of the locality.

The stone used in the facade of the Taj Bauri is of a warm sepia brown, lighter and richer in tone than any other building. It was quarried from the well which is excavated entirely from the basaltic trap.

The stone used in the Mehtar Mahal was not the basaltic trap of the locality. It is the laminar limestone, which is popularly known to geologists under the name of "Kurnool Limestone" found near Talikota, about 30 miles south-east of Bijapur. It begins to appear under the trap and lies between it and the granite. The grain of this stone is very close and fine, the texture hard and tough; its colour, a light yellowish or creamy grey. The transport of the material must have been very laborious and its working far more expensive and tedious than basalt, but no such work could have been executed in basalt and it was only the extreme tenacity of the material which admitted of the intricacy which has been imparted to the perforated brackets and other ornamental features.

The facades of buildings were sometimes finished in stucco-work (fine plaster) covered with gilding and colour. The entrance gateway to the Jami Musjid is richly ornamented with stucco-work in delicate arabesque patterns as also the palaces in the citadel and the floor of the Jami Musjid which was divided into spaces, each sufficient for one person at prayer; they are of white stucco, surrounded by a rim of black.

There are many buildings in which the brickwork is only covered with an exceedingly fine white plaster, the working of which has developed into a fine art in India.

When stone was too expensive an excellent substitute was found in this white plaster. A fine white sand or powdered limestone was used with it; the lime was made in some places from the chips left by the stone cutters, in others from sea-shells. It was so hard and tenacious that it could be used for floors as well as for walls and roofs.

For decorative purposes it could be used as a ground for fresco painting and gilding. For these purposes, it was frequently applied to buildings faced with stone.

This art of fine plaster work is known as "Indian Stucco".

It may be of interest to note that in the Pearl Mosque, it is said that powdered pearls were mixed in the plaster itself.

Most of the damage that has overtaken the monuments has been caused by the cracking and snapping of brackets, tie beams and cornice slabs.

● THE SECRET OF CONSTRUCTION :

The most daring piece of work carried out by the Bijapur builders, in defiance of the ordinary rules and regulations for the construction of buildings was a "hanging ceiling". This mode of ceiling has baffled many modern architects. Upon close examination it is found to be composed of slabs of stone, set edge to edge, with no apparent support. But the architect not only foresaw exactly what he wanted and how to accomplish it, but he had that thorough confidence in his materials, without which no builder ever yet produced anything that was lasting. These old Bijapur buildings have stood the best test any could stand, that of time, and the result proves amply that their builders knew what they were about. The whole secret of this amazing feat, is the great strength and tenacity of the mortar used.

The ceiling of the principal apartment of the tomb of Ibrahim Rouza is one of the most curious and interesting specimens of architectural skill at Bijapur, for it is flat and constructed with stone ribs and slabs set edge to edge, only supported by iron clamping and the strength of the excellent Indian Mortar, without any appearance of arch construction about them.

The ceiling of the entrance hall of the Mehtar Mahal, as well as the ceiling of the upper floor, is constructed in the same manner as that at the Ibrahim Rouza. This is the secret, too, of this flat ceiling.

At the north-east corner of the Taj Bauri is a partly destroyed dome. It is rather flat and is constructed in the same way as this ceiling, with a lining of great flat slabs, which, by themselves could not possibly stand. But they are nothing more than the stone lining of a concrete ceiling, the shear adhesive strength of the mortar keeping them in position. Although the ceiling, as a whole may remain intact yet there is the danger of individual stones dropping out, and this is guarded against by rabbeting the edges and in many cases, fastening adjacent stones with iron clamps.

Such a skilfully built "hanging ceiling" shows that in structural technique the Bijapur masons were masters of their craft.

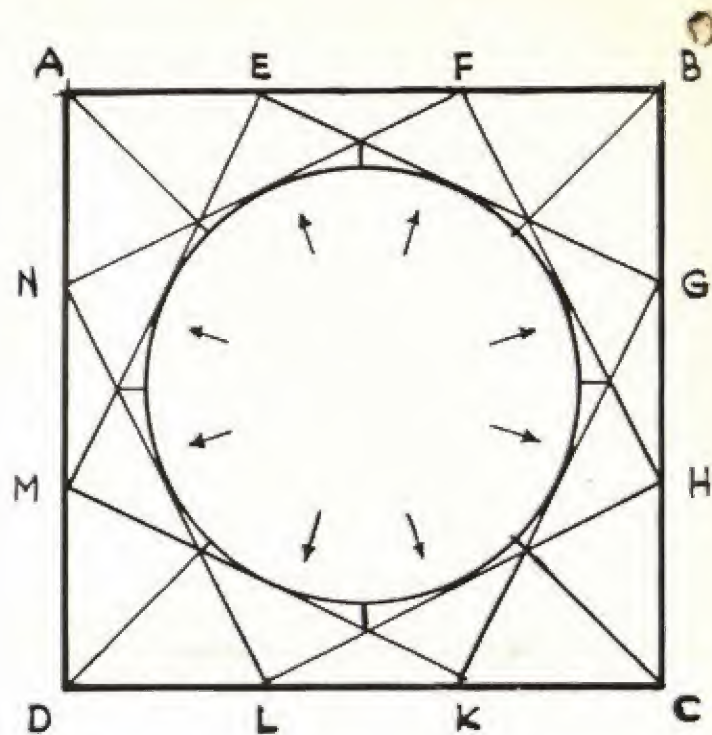


Illustration No. 2

PENDENTIVES

● THE PENDENTIVES :

The famous pendentive system of raising and supporting heavy domical structures was a foreign device introduced in the Deccan from Central Asia *via* Persia during the 14th & 15th centuries. This device, though ever so very artistic and mechanically sound, was not much made use of by the Moghals in their buildings in the North. Even in the Deccan, the device ceased to be widely popular by the end of the 17th century on royal buildings and was hardly adopted to their needs by the builders of private houses.

The diagram (shown in illustration No. 2), explains the arrangement of the pendentives. ABCD is the square room to be covered in. Points are taken in the walls at E, F, G, H, K, L, M and N, so that they form the corners of an octagon. At these points buttresses of piers are built up the walls to carry arches. The latter are then thrown across from one pier to an alternate pier, so that the arches, thus constructed, form, in plan, two intersecting squares E G K M & F H L N and the crowns of all the arches fall upon a circle inscribed within these squares and carry the dome. It will thus be seen that the dome rests directly upon the crowns of the arches, which are always pointed, and the former, being a solid mass of concrete, like a shell, with no loose voussoirs, rests as a dead weight upon the crowns of the arches, conveying no outward thrust to them. The lines joining the intersections and points of the arches, and the corners of the outer square, cut up the space, between the circle and these corners, into a number of concave spherical triangles. These are the "pendentives". (See illustration No. 3)

The combination of the square and the circle played an important part in English architecture of the late 18th century. Fanciful dispositions were developed in all countries during the Renaissance period which prove the desire felt by designers to achieve novelty within certain limits. The circular plan used over a square sub-structure was originally developed by Byzantine dome builders. In such a design as this, the first requirement was to obtain four perfectly stable arches, on which the dome might rest. Accepted in all countries throughout the Renaissance period, this application of geometry to the solution of a structural problem frequently occurs in modern buildings. The dome instead of being placed directly upon the pendentives can now be raised above them upon a cylindrical wall of the required height to admit light.

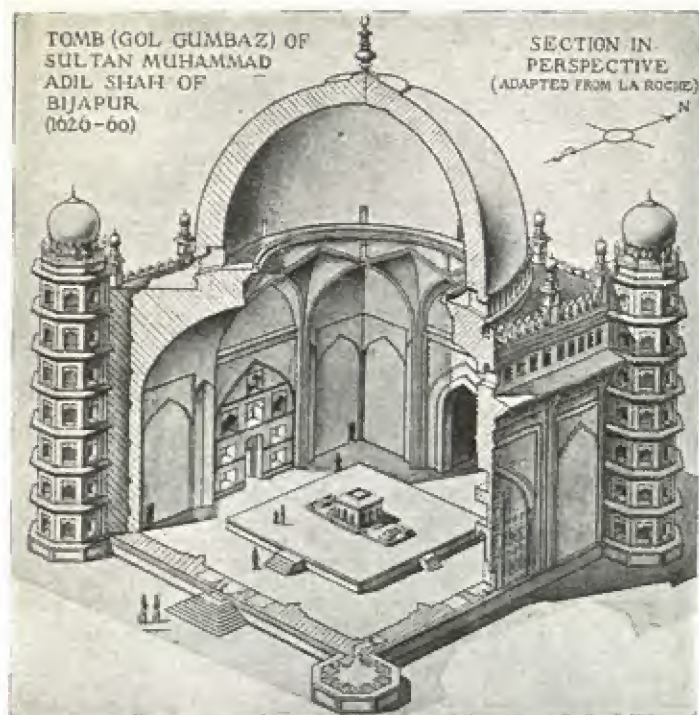


Illustration No. 3

SECTION OF GOL GUMBAZ

● ARCHITECTURAL STYLE :

The architectural period of Bijapur corresponds very nearly with the Renaissance period in Europe.

The architectural buildings of Bijapur comprise mosques, tombs and palaces; the first two classes of buildings predominating.

The architectural history of Bijapur forms a singular contrast with that of Ahmedabad. It would be in vain to look for much Hindu influence in the Mahomedan architecture of Bijapur and in fact nothing at all similar to what is found at Ahmedabad exists in that city.

There are certain characteristics in the fully matured architecture of Bijapur which are predominant. The chief among these is, that all-important feature "the dome", which, is almost spherical in shape and rises out of a band of conventional petals at its base. These forms were repeated to a small scale as an ornamental finish to the turrets. The domes of Bijapur are as a rule, lost internally in their own gloom, they have seldom any clear-storey lights and where they do exist, as in the mosque at Ibrahim Rouza, they are too low. The domes of Ahmedabad are raised above the general roof upon pillars and the light and air are freely admitted.

One device which was perfected and more extensively used at Bijapur in the construction of domes, was the happy idea of the "pendentives" which completely solved their problem of stability in a very graceful and beautiful manner.

Other prominent features are the graceful "minarets" that flank the mosques and rise above the corners of some of the tombs. They are not like the Ahmedabad and Gujarat ones, receptacles leading to galleries round them at different heights.

The typical Bijapur "arch" is of the four-centred variety. Sometimes the arches are, as a rule, two-centred. Sometimes they are struck from a single centre and the curves are carried up from the springing to a point in the haunches, whence tangents are struck to the crown.

The "pillar" is rare in the architecture of Bijapur, its place being taken by substantial masonry piers, usually rectangular in section.

Finally there is the "chajja" a characteristic architectural ornament, in most buildings, remarkable for its size and projection and for the decorated brackets by which it is supported.

The typical examples which represent the building art in its most significant aspects are the Jami Musjid, one of the earliest monuments to be constructed and therefore the most simple; the Ibrahim Rouza, one of the most elaborate, the Gol Gumbaz showing the style in its most grandiose form and the Melhtar Mahal, depicting it in its miniature and at the same time its most refined and delicate manner.

There is nothing in India which can compare for grandeur of conception with the Gol Gumbaz, nor any so elaborately rich in ornamental detail as the Ibrahim Rouza. The tombs of Humayun and Akbar will not bear comparison with them. Some will no doubt be inclined to think that the Taj Mahal at Agra is superior to anything in the south. The situation of the Taj on the banks of the Jumna surpasses that of any building at Bijapur and it retains its gardens and its range of marble fountains, which every Rouza had, but only very few indeed now possess; all these add immensely to the charming effect of the Taj Mahal, as it now stands. With the same advantages the architect of the Gol Gumbaz would certainly have produced a far grander building, and the architect of the Ibrahim Rouza one more picturesquely magnificent. Indeed, for certain qualities, the buildings at Bijapur stand quite alone among the examples of Saracenic art, and these qualities, rank very high among the art principles.

● HISTORIC MONUMENTS :

It is now proposed to give an account of some of the important historic monuments built during the Adil Shahi dynasty and they are given in the order they were built by each successive ruler. It is most unfortunate, that in a majority of cases, the names of the architects or builders responsible for the design and execution of the buildings are not known.

● JAMI MUSJID :

The real building period of Bijapur did not commence until Ali Adil Shah I ascended the throne. He was a great patron of Art and welcomed artists and craftsmen to his capital. One of the first buildings undertaken was the Jami Musjid (illustration No. 4), which for simplicity of design and impressive grandeur stands unrivalled. It is the largest religious edifice in the Deccan.



Illustration No. 4

JAMI MUSJID

The Jami Musjid, built in 1573, is considered to be the finest example of Bijapur architecture in its more restrained and classical mood and it is the best proportioned building in the city. Unfortunately it was never fully completed. An entrance gateway was provided later by Mughal Emperor Aurangzeb in the 17th century. It is said that every succeeding monarch upto the period of Aurangzeb contributed something to its perfection.

The most beautiful feature, architecturally, of this building is the central dome, which, though less than half the diameter of that covering the tomb of Mahomed, being only 57 feet as compared with 124 feet, is still so elegant in itself. It is also the first example we meet with of that form of pendentive, which is, so far as is now known, peculiar to Bijapur and is perhaps the happiest thought in dome building which has yet come to light. The shape of the dome is segmental and not bulbous as the other domes in the city. The idea of "bud" in the Mahomedan domes is emphasized by a row of petals around the base.

The interior of the Mosque, except the decorated mihrab, is severely plain. The walls and piers are all faced with white plaster. Round the outside of the building runs a deep corridor, and it is mainly the arches of this corridor that break the monotony of the plain walls of the exterior.

The only portion of the Mosque that is richly ornamented, is the "Mihrab" beside which is the marble pulpit. The whole surface of the mihrab is covered with rich gilding upon a coloured back-ground. It shows the richness and variety of the ornamental designs, which are in polished white stucco like marble, and the peculiar beauty of the sentences from the Koran. This splendid specimen of decoration is fortunately still in perfect preservation. The original velvet curtain for the mihrab is still in existence.

The rich decoration of the mihrab was not in the original plan of the mosque. In fact it was carried on by Sultan Mahomed Adil Shah who appeared to have a fondness for coloured decoration. It was he who adorned the walls of the Asar Mahal and decorated the walls of the Sat Majli.

The floor of the Musjid was altered by Emperor Aurangzeb and divided into compartments, each of which was to accommodate one worshipper. They are of white stucco, surrounded by a rim of black. There are 2,250 such compartments.

The massive gold chain which hung from the apex of the dome was taken away by Aurangzeb when the City was captured in 1686.



Illustration No. 5

JANJIRI MOSQUE

● JANJIRI MOSQUE :

The Janjiri Mosque (Illustration No. 5), also known as Malika Jehan Begum's Mosque, was built about 1586, by Ibrahim II.

It is one of the prettiest, exceedingly neat and graceful Mosques in Bijapur, with a good and well proportioned cornice and minarets. The rich facade, the graceful minarets and the fine stucco ornament of the dome are noteworthy. The dome rises over the central bay before the mihrab. Along the top is an ornamental perforated parapet.

There is a tank in front of the mosque. It is dry and empty now as the old water works have not been repaired.

A great deal has been done to this building in the way of repairs and most of the beautiful cornice which had been badly damaged has been restored, together with the portions of the perforated parapet.

● ANDU MUSJID :

This mosque (Illustration No. 6) was built in 1608 by Itbar Khan, one of the ministers of Ibrahim II. It is a two-storeyed building, but not a two-storeyed mosque. The mosque proper is on the upper storey. The ground floor is perhaps a rest-house only. There is a terrace in front of the mosque. The reason for placing this mosque upon the second storey is not quite apparent; it was perhaps a whim and nothing else. The ground floor is severely plain and the general appearance is greatly enhanced by the numerous offsets and recesses.



Illustration No. 6

ANDU MUSJID

The mosque is about the best built of any in Bijapur. The surface of the stones is all but polished, having probably been rubbed down with sand and water so as to efface all tool marks. The joints of the masonry are so fine that the edge of a sheet of note paper could barely be inserted between them. The front seems not to have been quite finished, the two large lower brackets under the cornice, one on the face of each pier, have not been inserted, but the corbels and slots have been made for them. A beautiful perforated parapet runs along the top of the building.

The principal dome and the smaller bulbs of the minarets are of the "ribbed melon shape" variety and so it is called the Andu or the egg-shaped Musjid. This feature is rare in Bijapur and occurs only in two or three buildings. That the masonry has stood the weather for more than 300 years is a certificate in itself.



Illustration No. 7

TAJ BAURI

● TAJ BAURI :

The building and the tank (Illustration No. 7) were built by Malik Sandal in 1620, in honour of Taj Sultana, the queen of Ibrahim II. The facade of the building, with its fine archway of 35 feet span, and centre minarets, though incomplete in one part, is extremely handsome. The apartments in the front portion of the building are spacious and comfortable, well lighted by perforated stone windows. The interior room is the most elegant of all, with a groined roof and pendentives in the corners, which support a dome, now in ruinous condition. There is no doubt that the whole building was intended as a caravanserai for travellers and visitors.

This is the biggest and largest and most finely built tank in Bijapur. The tank is square in shape, each side measuring 223 feet and has a depth of about 52 feet in the centre. It was excavated from the basaltic trap rock. It is enclosed within high walls. Descending the broad flight of steps, and going through the great entrance arch, we come to the landing, leading with steps, to the water on both sides.

The tank is fed by under-ground water. In days when Bijapur had no water-works, it was this tank which supplied water to one-fourth of the town in times of water scarcity. Above the sides of the tank are arrangements for raising water, those on the south being still used to irrigate the gardens behind.

The east wing of the Taj Bawri in front including the domical roof, is not in existence to-day, except the end bay. There is, therefore, a good scope for the student of architecture to restore this structure.

● MEHTAR MAHAL :

The Mehtar Mahal (Illustration No. 8) is a perfect little gem of Bijapur architecture probably built in the reign of Mahomed Adil Shah. Although styled a 'Mahal,' it is

in fact a gateway to the inner courtyard of a mosque. It has upper rooms and balconies above the entrance from which people in olden times must have enjoyed a fine view of the royal capital.

The general outline of the Mehtar Mahal is a tall square tower with two slender minarets rising to a height of 66 feet. The architecture of the building resembles that of the Andu Musjid and the Janjiri Mosque. The old wooden doorway with its massive framing and curious iron bosses and nail heads is worth inspection. The most striking features of this building are the "balcony-windows". For pure gracefulness and delicacy of treatment, there is nothing to surpass them in Bijapur. Along the top of the building ran the beautiful lacelike parapet nearly the whole of which has been restored. It is on this portion of the building that the decorative skill of the artists has been so richly lavished. The ornaments of the cornices, brackets and mouldings, with the perforated brackets which support the eaves, over the windows, are beyond any question, the most perfect specimens of the art of stone-cutting in Bijapur and can only be appreciated by examination of the details.

To the student of architecture the most interesting peculiarity in the building is the essentially wooden character of the decoration. Though it is difficult not to feel the want of appropriateness to "stone architecture" in the details of the Mehtar Mahal, it is impossible not to be struck with the extreme delicacy of finish and the general beauty of the forms.

The stone used in this building was not the basaltic trap of the locality. It is the laminar limestone found near Talikota, about 30 miles from Bijapur.

The most noteworthy thing here is the very curiously arranged ceiling of the entrance hall. This, as well as the ceiling of the upper floor, is constructed in the same manner as that at the Ibrahim Rouza.



Illustration No. 8

MEHTAR MAHAL

The story that it was built by a Mehtar, that is, a sweeper or Bhangi deserves little credit. In fact the building has no connections with a sweeper. The Mahomedan priests (mullas) appointed a head amongst themselves. He was called a Mehtar. One Gadai, a mehtar, had accompanied Ali I on his visit to Vijayanagar. Ali received many presents there and he is said to have given them to the Mehtar. With this money Gadai built a Mosque and a gateway. The gateway now is called the Mehtar Mahal or Bhangi Mahal, the latter being a pure misnomer.



Illustration No. 9

IBRAHIM ROUZA

● IBRAHIM ROUZA :

Ibrahim Rouza (Illustration No. 9) forms a group of buildings which includes the tomb proper and the mosque, as also their gateways and their terraces. It is said to have been built by Malik Sandal in the year 1626. At one time, this lovely tomb was surrounded by a beautiful garden with rills of water running through it.

But what strikes the visitor of this tomb most is the amazing wealth of decoration to be found on the exterior walls of the sepulchral chamber and the doors and the ceiling of the corridor that surrounds the chamber. The decoration chiefly consists of "shallow surface tracery" and interlaced writings from the Holy Koran. It is said that the whole text of the Koran has thus been transcribed on these walls. The windows are beautiful specimens of perforated stonework interlaced with Arabic writing. The doors of these walls are of teak, divided into carved panels, containing the words, "Allah is one", "Allah is present", "My helper is Allah". The pillars in the corridors are very Hindu in style and have little that is Saracenic about them.

The deep rich cornices, the graceful minarets, the perforated parapets and the miniature minars round the bases of the corner minarets all go to show that the labour expended and the art manifested has been unstinted. Under the cornice of the mosque may be seen the remnants of heavy chains with pendants. Each of these has been carved out of a single block of stone.

Here again we are met by the fact that the cornices, which form the richest part of the external decorations, are copied from wooden originals, not so directly as in the Mehtar Mahal, but still the forms are such as could not be invented in stone.

In this building we are introduced for the first time to a new feature in Mahomedan Architecture by the introduction of a tall dome employed as an external ornament. It was afterwards employed in the Taj Mahal at Agra, and became fashionable with the bulbous form of dome both in India and Persia. The Pantheon at Rome, St. Sophia at Constantinople and generally all the earliest and the best Byzantine domes, fail in effect externally, exactly in proportion to their success internally. Their builders considered the interior the more important part of their edifices and

took no pains to render the external forms of their buildings beautiful. When the Renaissance architects in the 15th Century attempted the problem, they tried to emulate the tall forms of Gothic Architecture and ran into opposite extremes. In St. Peter's and St. Paul's, beauty of external form is what their architects were aiming at. The interior is made too lofty for its other dimensions and thus becomes generally very destructive of the proper proportions of the rest of the building. The Saracenic architects in Egypt, Persia and India, came nearer to a happy proportion between these two elements than was ever accomplished in Europe.

● GOL GUMBAZ :

Gol Gumbaz (Illustration No. 10) is the mausoleum of King Sultan Mahomed Adil Shah. It was built in the year 1656 and is one of the finest structural triumphs of the Indian builders. This magnificent mausoleum, with its gigantic dome and renowned whispering gallery, has been a source of attraction to visitors from all parts of the world.

The general appearance of the building is that of a great cube surmounted by a large hemispherical dome with an octagonal tower at each of the four corners of the cube. If the octagonal towers are left off, then the building consists of only one great compartment covered by a dome. The building rests on a foundation of solid rock.

The most notable architectural feature of Gol Gumbaz is the massive cornice which runs round the building and projects 11'-6" from the wall. One curious thing to be observed above the entrance gate is a "meteoric", popularly known as Bijli Pattar (the lightning stone) which is said to have fallen in the vicinity during Muhammad's reign. The stairways leading to the roof, as in most of Bijapur mosques, are in the thickness of the end walls. In this, they differ very much from the Ahmedabad buildings, where the stair is a spiral passage winding up through the minarets.

The architect of the Gol Gumbaz aimed at producing the most mechanically imposing building which he was capable of conceiving. He proposed to surpass all other tombs in mechanical grandeur just as the designer of the Ibrahim Rouza had wished to excel in artistic ornamentation. The architect who conceived and carried out the very stupendous task of hanging a mighty dome right across the whole expanse of the outer walls, has indeed executed a remarkable feat.

The condition of the dome was very alarming some years ago, as serious cracks, due to several causes, had developed on the extrados of the dome, some of them being two feet wide. Before the last World War, the whole dome was re-conditioned by the application of "Gunite" at a considerable cost.



Illustration No. 10

GOL GUMBAZ

The dome of the Gol Gumbaz, one of the largest existing hemispherical domes of masonry, has an inside diameter of 124 feet 5 inches and is carried on pendentives over a hall 135 feet 5 inches square, the thickness of the shell is about 9 feet at the summit and 10 feet at the springing. The extreme height to the apex of the dome from the base of the building is 198 feet 6 inches. At its springing level, the dome houses the famous whispering gallery, 11 feet wide, which hangs out into the interior of the building, 109 feet 6 inches above the floor. Above the floor of the gallery, the wall is approximately vertical for a height of about 10 feet. The dome around the gallery is perforated with eight open doorways.

A close inspection of the inside of the dome, wherever it was exposed, showed that the bricks are laid on flat in lime mortar and the thickness of the joint varies from 1" to 2" at places. The bricks are of varying size and do not appear to be very systematically laid.

The accompanying table gives a comparison between the mechanical excellence of the Gol Gumbaz and other celebrated examples.

	Form at base.	Internal Dia. feet.	Height Internally feet.
The Pantheon at Rome	..Round	142	146
St. Peter's at Rome	..Round	137	333
Gol Gumbaz, Bijapur	..Square	135	175
St. Paul's, London	..Round	108	220
St. Sophia, Constantinople	..Square	107	182
Taj Mahal, Agra	..Octagon	58	80

The most popular feature of Gol Gumbaz that has attracted tourists from all parts of the world is its Whispering Gallery. On entering the gallery one is struck with the loud echoes that fill the place in answer to the footfall. Loud laughter is answered by a score of fiends. The slightest whisper is heard from side to side at a distance of 124 feet and a single loud clap is distinctly echoed 14 times.

(A detailed account of the Gol Gumbaz, relating to the Whispering Gallery, Acoustical Investigation, Laboratory tests of plaster and extermination of sparrows, written by the author of this article, appeared in the October 1946 issue of the "Journal of the Indian Institute of Architects.")

● SAT MAZLI :

The Sat Mazli, known as the Palace of Seven Storeys (Illustration No. 11), was built by Sultan Mahomed Adil Shah for the residence of his favourite mistress, Rhumba. Although a good deal ruined, enough remains to render its plan and appearance intelligible. Like all the palaces in the citadel, it depends on stucco, covered with gilding and colour, for its ornamentation. The building stands high above all other palatial ruins and in design as well as details is an extremely good specimen of Deccan Mahomedan Architecture. The height of the building as it stands now is 97 feet. The height suggests that it must have served the purpose of a glorified royal watch-tower for the kings of Bijapur in those eventful times. At present there are only five storeys remaining and the other two storeys have disappeared.

From the top of Sat Mazli a fine uninterrupted view of the city on all sides can be obtained. It is by no means a handsome looking building today. The building would seem to have been erected as a pleasure house wherein to spend an idle hour and from the higher storeys of which to sit and watch what might be going on in the City or in the country around.

The characteristic feature of this building is the number of water-pipes and bath cisterns found in every possible part of the building including the walls. The cooling effect of water was well appreciated and made use of by the kings. From this it is clear that Sat Mazli was meant for pleasure and royal baths.

The walls were covered with paintings but there is no trace of these at present. It is said that the walls were also richly and beautifully gilded, but they were later scraped off by the orders of the Raja of Satara. The rich and beautifully carved woodwork which Sat Mazli once possessed, was also removed.



Illustration No. 11

SAT MAZLI

● ASHAR MAHAL :

The Ashar Mahal (Illustration No. 12) was built in 1646 by Sultan Mahomed Adil Shah.

It is a great open building, the front part being an open hall supported by wooden pillars. It consists of a ground floor and a storey above, in which are the principal apartments. The front verandah, 120 feet long and 33 feet broad, runs the whole length of the building. The tall pillars of the front are massive teak pillars of 35 feet in length and 4 feet dia. at base, dressed into an octagonal form. The woodwork of this verandah and generally of the whole palace, the fittings of the windows, and their carved brackets show that the carpenters of Bijapur were in no degree inferior to the stone-masons of the same period.

It was originally meant to be the Hall of Justice. It was known as 'gilded hall' on account of its ceiling of panelled wood having been covered with gold-leaf and the fine ceiling is worth noting. It was here that Mahomed sat upon his elevated seat and administered justice.



Illustration No. 12

ASHAR MAHAL

● SISTER DOMES :

The domes of the tombs are exactly alike and adjoin each other ; so they are known as sister-domes or twin-domes (illustration No. 13). The octagonal building on the south is the resting-place of Khan Muhammad and his son Kharvas Khan. In the tomb of Khan Muhammad is one of the finest and spacious halls in Bijapur. Below the hall, are the vaults where the real graves are.

The larger square tomb is that of Abdul Rezak Qadir and was, no doubt, built at the same time as the other. The tomb is very plain.

Like the Gol Gumbaz these two tombs have galleries inside the domes, but as they are small, they have no distinct echo.

The floors of both tombs are at a very considerable elevation above the surrounding ground level, which is due to the vaults, containing the graves, being built upon the ground rather than beneath its surface, as is the case in most tombs.



Illustration No. 13

SISTER DOMES

● UNFINISHED TOMB OF ALI II :

This last and unfinished royal tomb (illustration No. 14), lies a few yards from the Traveller's Bungalow. The tomb is now popularly known as Bara Kaman. The great elevated basement on which the great tomb was to stand is 215 ft. square, while that of Gol Gumbaz is 158 ft. square, and hence would have covered the greatest area of any building in Bijapur.

The most peculiar characteristics of the building are its arches. They are purely Gothic in outline, having been struck from two centres, the curves being carried up to the crowns. The form of arch otherwise universal in Bijapur, is that where the curves, struck from two centres, and rising from their springing, at a certain point, tangents to the curves which continue the archway to the crown. This departure from the usual type gives the building rather the appearance of an old Gothic ruin, and these rings which remain to this day, have regular voussoirs and keystones.

Although the tomb was unfinished, Ali was buried within the building, his grave being represented by the great tombstone on the central platform.

It is unfinished, however, like many tombs in the east, and as must too often be the case where kings undertake the erection of their own sepulchres. The Egyptians, with their usual practical sense, seem alone among the tomb-building races, to have solved the problem. In that country the king went on adding chamber to chamber, burrowing deeper and deeper into the hillside, till death arrested his career and the progress of his last resting-place. But the tomb was complete with the first chambers, the extension merely shadowed forth the length of his reign and splendour

of his kingdom. With a structural building this is not so easy. A tomb must be square or polygonal in plan. It must be set out symmetrically around a central point. If on too large a scale to be finished before the king's death, like this one of Ali II, he leaves only a ruin.

The whole surface of the massive masonry has been left rough for a subsequent coating of plaster. The building is a standing lesson to the present-day masons. The rough-looking stones are so ingeniously joined and with the least quantity of mortar that on seeing the structure one can't help but say—"our forefathers were great builders."

● CONCLUSION :

From the account given above one would come to the conclusion that the architecture of Bijapur had its own peculiar characteristics and it is now upto the young architect to incorporate in his designs these essentials to suit modern conditions.

At present there is a "Modernistic" spirit prevalent among students and practising architects throughout India. I feel, that traditional architecture should be taught as thoroughly as planning and construction in order to give the student, at the end of his training, a solid foundation on which to work, whether he decides for "tradition" or "modernism" or both.

The intelligent restoration of historic buildings can only be safely entrusted to those who are genuinely in sympathy with the great architecture of the past.

I am of opinion that the teaching and practice of the subject of architectural design should be sufficiently conducive to encourage good Indian traditions and to evolve a style characteristically Indian in due course of time.



Illustration No. 14

UNFINISHED TOMB OF ALI II

THE GOL GUMBAZ AT BIJAPUR

- *Whispering Gallery*
- *Acoustical Investigation*
- *Laboratory Tests of Plaster*
- *Extermination of Sparrows*

By

Mr. S. S. REUBEN, F.R.I.B.A., F.I.I.A.,

Assistant Professor of Architecture, Sir J. J. School of Art, Bombay.

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GOL Gumbaz, the ancient historic monument, is the mausoleum of King Sultan Muhammad Adil Shah, one of the Bijapur kings who reigned from 1626 to 1656. Today this well-known and famous edifice is the pride of India. It was built in the year 1656 A.D. and is one of the finest structural triumphs of the Indian builders, built with local materials obtained from the surrounding districts. This magnificent mausoleum, with its gigantic dome and the renowned whispering gallery, has been a source of attraction to visitors, not only from all over India but also from the distant parts of the world.

It was the ruling passion of the Mohamedan kings of the Adilshahi dynasty (1489-1685) to build a memorial or an architectural monument in their lifetime, for their remains after death, which has been the main cause of these exquisite and grand works of art. The architectural buildings of Bijapur comprise mosques, tombs and palaces, the first two classes of buildings predominating. The famous buildings have now come under the care of the Department of Archaeology and today the chief monuments of the city present a neat and well protected appearance.

The architect of the Gol Gumbaz aimed at producing the most mechanically imposing building which he was capable of conceiving. He proposed to surpass all other tombs in mechanical grandeur just as the designer of the Ibrahim Ruza had wished to excel in artistic ornamentation. The system of pendentives, which is famous in India, is, without doubt, the most successful and most graceful method of construction of domes. The architect who conceived and carried out the very stupendous task of hanging a mighty dome right across the whole expanse of the outer walls, has indeed executed a remarkable feat. But it is most unfortunate that his very name is now unknown.

The dome of the Gol Gumbaz, one of the largest existing hemispherical domes of masonry, has an inside diameter of 124 feet 5 inches and is carried on pendentives over a hall 135 feet 5 inches square, measured internally. The thickness of the shell is about 9 feet at the summit and 10 feet at the springing. The extreme height to the apex of the dome from the base of the building is 150 feet 6 inches. At its springing level, the dome houses the famous whispering gallery, 11 feet wide, which hangs out into the interior of the building, 109 feet 6 inches above the floor. Above the floor of the gallery the wall is approximately vertical for a height of about 10 feet. The dome around the gallery is perforated with eight open doorways.

The building most resembling the Gol Gumbaz is the Pantheon at Rome. The Pantheon is a circular building, the diameter of which is 142 feet, its area being 15,833 square feet. The tomb of Muhammad is square, each side being 135 feet; its area, therefore, is 18,225 square feet, that is, more than one-eighth in excess. The construction of the Roman dome on a circular drum is simple and easy. That of the Indian tomb, having to be worked up from a square, was one of the most difficult problems that could be proposed to an architect and must have involved engineering skill of the highest order.

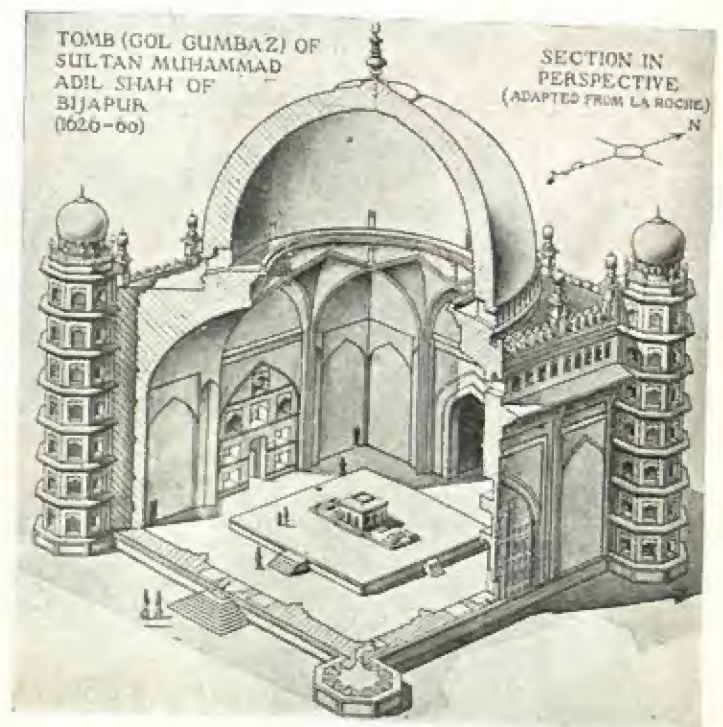
The Gol Gumbaz possesses wonderful acoustic properties, which could be classified as follows :—

- (1) A longer time of Reverberation Period.
- (2) The Phenomenon of Multiple Echoes.
- (3) The Whispering Gallery effect.

• WHISPERING GALLERY :

The most popular feature of the Gol Gumbaz that has attracted tourists from all parts of the country is its Whispering Gallery. By the term "Whispering Gallery" is usually understood a building or a room either artificial or natural in which faint sounds can be heard across extraordinary distances. In the Gallery of the Gol Gumbaz benches are provided at four places at equal distances in the gallery and they are very close to the wall. When a person, sitting on one bench, whispers near the wall, he can be heard at any point on the circumference. But the effect is most pronounced when the speaker and the hearer are at the opposite ends of a diameter. Under ordinary conditions a whisper is hardly audible at a distance of a few feet.

On entering the gallery one is struck with the loud echoes that fill the place in answer to his footfall. Loud laughter is answered by a score of fiends. The slightest whisper is heard from side to side at a distance of 124 feet and a single loud clap is echoed 14 times distinctly. Other instances of multiple echoes are the famous dome of the Pantheon at Rome and the Whispering Gallery of St. Paul's, London. This phenomenon of multiple echoes was not deliberately planned, but is the natural result of the huge size of the dome. It requires more than 65 feet between a person and the reflecting surface, in order that the sound of the voice may, on return, reach his ear, after the cessation of the original sound, to create the impression of a second sound or echo. If a greater distance intervenes, the echo is more distinct, as more time separates the original from the reflected sound. If the distance is less no distinct echoes result, as the original and reflected sounds overlap and produce a confound-sound or resonance. In the smaller domes we get what is called resonance, their diameter not being sufficiently great to allow of a distinct echo.



FROM INDIAN ARCHITECTURE

by Percy Brown



THE GOL GUMBAZ

Photo: B. M. Billimoria

• ACOUSTICAL INVESTIGATION :

The observations made and the results of the Acoustical Tests carried out at the Gol Gumbaz by the writer in the presence of the members of the Annual Study Excursion Party of the Sir J. J. School of Art, Bombay, at Bijapur are recorded below :—

Date : 24th October 1945.

Place : The Gol Gumbaz, Bijapur.

Time of Investigation : 8 A.M.—10-0 A.M.(I.S.T.).

Source :	Reverberation in Seconds :		
	(by stop-watch)		
	1st stage.	2nd stage.	3rd stage.
1. MOTOR CAR HORN ..	14½	13½	14
2. BUGLE	14½	15	15½
3. SUSTAINED SHOUT ..	12	12½	11½
4. LOUD SPEECH ..	11	11	11½
5. PISTOL SHOTS ..	14	13½	13½
6. MEGAPHONE ..	10½	11	11½
7. BEATING A TURBAN CLOTH on the parapet of gallery ..	13	14	14
8. TURBAN CLOTH BALL thrown on the floor below from the gallery (height 109'-6")	13	13½	13½

	<i>Number of Echoes :</i>		
1. FALL OF FOOTSTEP	5	6	7
2. ORDINARY SPEECH	2	3	3
3. HANDCLAP	12	12	12
		clear and then fading.	
4. HANDCLAP (repeated)	14 clear, and 3 fading.		
5. METRONOME ..	5	5	5
	(low)	(medium)	(high)

Other Observations :

1. Dropping a coin	} All these sounds were clearly heard at a distance of 124'-0".
2. Lighting a match	
3. Tearing a paper	
4. Dropping a match-box	
5. Whisper	Was very clear.
6. Pin dropping	Not heard.
7. Tick of alarm clock	Not heard.
8. Mattress above speaker	Hearing conditions were somewhat poor.

It may be mentioned here that in previous years the acoustical properties of the Gol Gumbaz have been investigated by two leading scientists of Bombay : Principal H. J. Taylor and Principal G. R. Paranjpe, who have both conducted experimental measurements inside the Gol Gumbaz ; but so far no practising Architect or Engineer in India has taken the initiative. The experiments carried out by the latter have enabled a regular gramophone record to be made wherein the number of the echoes can be accurately counted and which have been registered by a Sound Recorder.

It is difficult to say whether the effects observable today are as good or better or worse than they were some years ago. It was found that at present the acoustic properties of the dome have been impaired owing to the uneven inner surface of the dome, due to the dropping of plaster at several places. On superficial examination it is found that approximately 300-400 square feet of plaster from the soffit of the dome has already fallen out. This is chiefly due to the damage done to the plaster by the sparrows housed in the plaster crevices and partly due to the vibration caused to the building owing to the location of the railway lines nearby. Further deterioration in the acoustical properties will occur if this state of affairs is allowed to continue and is neglected for some time more. It is therefore absolutely necessary to take immediate steps to improve the acoustic properties of this dome by replastering the whole inner surface of the dome with a smooth and hard plaster, preferably Victorite plaster.

If this important work of replastering the inside of the dome is undertaken it will involve not only heavy expenditure but will call for engineering skill of the highest order, particularly in the construction of a scaffolding to this great height.

• LABORATORY TESTS OF PLASTER :

A sample of plaster sab which had fallen from the inner surface of the dome of Gol Gumbaz has been tested by the College of Engineering, Poona. The results of the Laboratory Tests in respect of the Chemical Analysis of the plaster slab are given below :—

CHEMICAL ANALYSIS

1. Insoluble residue containing sand grains of various sizes	13.85%
2. $\text{Fe}_2\text{O}_3\text{Al}_2\text{O}_3$	11.19%
3. CaO	38.43%
4. CO_2	30.19%
5. SO_4	5.70%
6. MgO	A trace
7. Alkalies, moisture by difference	0.5%
	100.00%

From the above results it will be observed that the plaster is composed of lime and sand in the proportion of 3 : 1 approximately.

• EXTERMINATION OF SPARROWS :

During the experiments it was noticed that there was some disturbance caused on account of the presence of the sparrows who were sending their own notes. These sparrows are housed in the plaster crevices of the dome and their presence is detrimental to the acoustic properties of the dome as they have already damaged portions of plaster causing collapse at some places from time to time, and further, they have been found to be a nuisance in the Whispering Gallery, thereby marring the excellent whispering effect.

The following two remedies are suggested, which will drive them away completely from the building :

- (1) To use tear gas with the help of a foot-pump ; it should be distributed at several points in the gallery so that the distribution may be uniform.
- (2) To burn sulphur in the form of powder or sticks for a few hours, preferably at a higher level, on a platform 10'-0" to 15'-0" above the level of the gallery and uniformly distributed at several points in the gallery.

The above two experiments will completely drive away the sparrows from the building and will probably kill some of them during the experiments. It is very likely that they will return after a few weeks but their entry could be prevented by filling in the panels of the eight doors in the Gallery

with wire-netting or some jali of a small mesh or by providing flush panelled swing doors.

It is very essential that the work of extermination of the sparrows should be taken in hand immediately so that it may not result in further deterioration of the acoustical properties.

I take this opportunity of expressing my sincere thanks to Principal H. J. Taylor of the Wilson College, and Principal G. R. Paranjpe of the Royal Institute of Science, Bombay, who were extremely kind to grant me interviews at their respective colleges, to discuss points relating to the acoustics of the Gol Gumbaz prior to my carrying out the acoustical tests and after. I have also to thank Mr. Q. M. Moneer, Superintendent, Archaeological Survey of India, Western Circle, Poona, and his assistants, who heartily rendered assistance to the members of the Annual Study Excursion Party at Bijapur, and enabled them to make their mission to this historic town a success.

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